



Pathologic Lesions of the Living Pulp under Gold Shell Crown.

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(Further report on Case XII in "ITEMS OF INTEREST" for Nov., 1908, by M. L. Rhein.)

What is the effect of a gold shell crown cemented over roots containing a living pulp? A careful investigation of the clinical methods in vogue at the present time, as compared with years ago, shows a constantly increasing ratio of pulp removal where an operation of this kind is to be performed. This is unquestionably the result of clinical deduction from the large number of alveolar abscesses that have been caused by such procedure. In a lecture before the New Jersey State Dental Society given in July, 1908, and published in the *ITEMS OF INTEREST* for November, 1908, a number of radiographs were presented for the purpose of showing the effects produced by placing such caps over teeth having living pulps. A favorite argument of those who still cling to this form of practice rests on the assertion that a certain percentage of cases of this kind have been under their observation for a number of years without any resulting alveolar abscess. The hypothesis that such operations are non-injurious is not based on sound pathological principles, when a careful consideration is given to the diseased condition that ensues from such irritation of normal pulps. Skilful radiography of many of these alleged successful cases would show an astonishing proportion of patho-

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logical conditions that are not suspected from external appearances. The gold cap, acting as an irritant, produces an inflammatory condition of the surrounding parts. The results of such inflammation can never be accurately predicted.

Microscopic examination of pulps subjected to such an irritation show an endless variety of pathogenic degeneration. The one most constant form of resulting lesion is the well-known calcific degeneration, either in the form of pulp nodules or in concentric calcific masses. With this calcific degeneration there are always present other pathogenic degenerations, but the character of these seems to vary in different cases.



FIG. 1.



FIG. 2.

Pulp removal has been placed on a scientific basis, and by means either of sodium and potassium, or of sulphuric acid, the finest canal can be explored to its end. (This excludes a very small percentage of abnormally distorted roots.) The practitioner who ignores the necessity of pulp removal and remains enamored of this illogical practice does not see all of his resulting failures. Alveolar abscess only results when infection has been able to take place, but the short life of many such roots capped over living pulps is rarely taken into consideration. How many such loosened teeth are removed by the patients' new dentist, to whom they have gone in despair, and been met by the statement that too little attachment remains to preserve the tooth in the alveolar socket? Unquestionably, most capped teeth of this class meet their fate in this manner. When considering the drain on the immediate circulation wherever this calcific pulp degeneration is taking place, it is only natural to suppose that this excess of arterial supply to the pulp is accomplished at the expense of the pericementum and ultimately of the alveolar socket itself.



FIG. 3.

Only in this way can the great amount of exfoliation of such capped teeth be accounted for. Taking all these factors into consideration, can it be successfully denied that pulps should be thoroughly removed and the canals aseptically filled before gold shell caps are cemented into place? A propaganda, with illustrative clinical excerpts, is needed to aid in bringing the profession to a practical unanimity on this subject.

In the lecture at Asbury Park a radiograph (Fig. 1) was shown, describing a case of this nature. The enlargement of the roots is most perceptible, and there can be but little question that the exostosis is due to this irritant. As the patient resides about one thousand miles from New York it was not until February of this year that an opportunity was afforded to remove the pulp of this molar. It was found to be living and fairly sensitive to the drill. It responded only partially to cocain

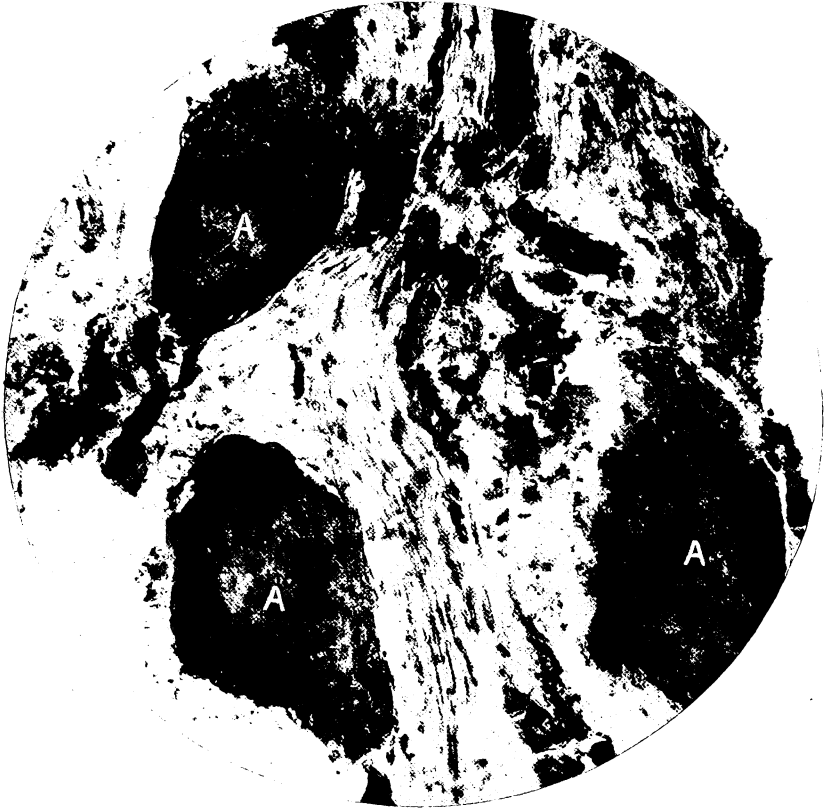


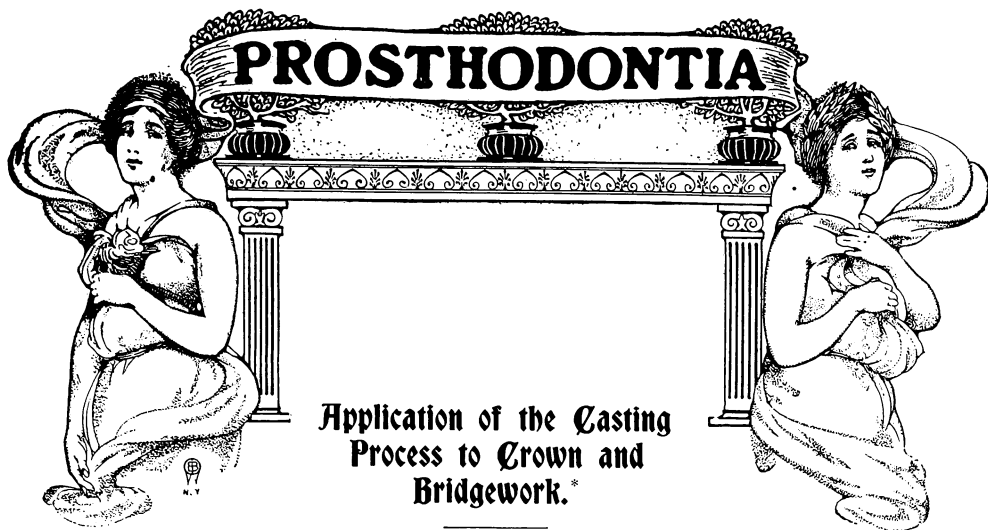
FIG. 4.

anesthesia by means of pressure on account of the extensive calcific condition present. On this account the removal of the pulp was very difficult and painful, and yet there were portions of the pulp tissue that would suddenly be reached, showing no sensation as though there was a partial anesthesia. A careful examination of the pulp under the microscope, as seen in Fig. 4 (A), indicates that these portions of the pulp tissue were necrotic zones which were developing in all directions, and it would only have been a short time before an abscess must have ensued, although the cap had been in position for over twelve years. Fig. 1 is a reproduction of Fig. 12 in the November ITEMS OF INTEREST, and clearly shows the result of the inflammatory action on the cementum and the pericementum. It appeared from the feeling of the broach when once

within the pulp chamber as though the entire pulp was calcified. It was on this account that it required a number of sittings with the use of sodium and potassium to reach the ends of the canals. A radiograph was taken after the sitting preceding the filling of the roots to determine how nearly the ends of the canals had been reached. This is shown in Fig. 2. Wires were placed in the distal root and in the two mesial roots. These show that they are not far distant from the ends of the canals, and only a little use of the sodium and potassium mixture was needed to reach the very end of each root canal. The pulp from the distal root seemed to be entirely calcified, and the sensitive nature thereof was in marked contrast to portions of the pulp from the mesial roots which seemed to be without sensation in some parts. Portions of the pulp from the distal root in a five per cent. formaline solution, and of the pulp from the mesial roots in a ninety-five per cent. alcohol solution were sent to Dr. Vida Latham to mount for microscopic investigation. The microphotographs, with an enlargement of 350 diameters, were made from these specimens, and are shown in Figs. 3 and 4. Fig. 3 shows a portion of the pulp of the distal root and nothing is to be seen but large concentric calcific masses with pulp stones scattered through the inflamed and nerve-thickened tissue. The inflammation has caused the thickening and degeneration of the nerve fibers so that it is possible to study at leisure the various stages leading to complete calcification. Fig. 4 is a section of the pulp removed from one of the mesial canals. We see some approach to normal nerve tissue surrounded by large cloudy swellings, marked A, which, taking no stain of any kind, are devoid of any tissue character, and can be nothing but necrotic areas. Small pulp stones are detected in the nerve tissue and the two microphotographs give an unusual opportunity to study the progressive appearances resulting from nerve degeneration under such circumstances. Dr. Latham remarks upon the unusual kind of hardness of this portion, stating that it cuts neither like tendon nor lime.

Is there much doubt of a future alveolar abscess starting from this pulp had no operative interference been undertaken?





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From even a cursory study of the almost unlimited array of procedures which have heretofore constituted the methods of practice involved in the construction and application of crown and bridgework, it will at once be observed that, notwithstanding the progress made, no one general or systematic line of procedure has ever prevailed.

While the myriad of individual methods and so-called "systems" which have from time to time been introduced and recommended, have embraced such varied and versatile efforts as to reflect great credit upon the ingenuity, progressiveness and enthusiasm of the profession, and while all of these have in a measure contributed to the development of this particular specialty, yet, until the advent of the casting process the methods of practice were necessarily largely empirical.

From the very first, however, the *casting process* seemed to portend such a scope of usefulness, and such an unlimited range of application to this, as well as to every other phase of prosthetic dentistry, as to ultimately revolutionize all former procedures. Indeed, with the development which has since been made along these lines, and which is still possible, most of them have already become more or less obsolete practices, and others will undoubtedly be abandoned from time to time as further development is made. In consequence, it seems safe to prophesy that fewer methods will be used, or needed, and that in the end better results will obtain.

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This seems the logical sequence for the reason that *accuracy of adaptation*, combined with a *maximum of inherent strength* may be compared with, and, therefore, should be recognized as *the keystone of the arch* in the successful application of all forms of crowns and bridges; and since the process of casting has made these essential features possible to a degree never before achieved in this work, and since it at the same time simplifies and expedites the procedure, it is unquestionably destined to become the universal practice of the future.

By insuring the success and permanency of the cemented filling, which, when the cavity has been properly formed and the filling well adapted, is now generally recognized and conceded, a very large proportion of teeth which formerly were restored to usefulness only by some type of artificial crown may now be filled and thus restored in a better and more permanent manner. Because of the absence of the primary cause of cervical disturbances, so frequently arising from some imperfection in the adaptation of the crown to the supporting root such restoration must be regarded as a better procedure, whenever and wherever applicable, for the reason that no matter how carefully a crown may be fitted, no condition possible to obtain is quite so conducive to the permanent comfort and longevity of the root as is the normal.

The same degree of accuracy which insures the success of the inlay, however, is also possible in the construction of artificial crowns when they are demanded, irrespective of how well preserved or how badly broken down the root may be, or whether the crown is to restore but a single tooth, or to become part of a bridge in addition thereto.

Thus the possible irritating influences due to the presence of an artificial crown as formerly constructed are practically eliminated, and in addition to this the various forms of separable dowel or detachable porcelain crowns, instead of the ordinary thin facings, may now be successfully used.

Such types of porcelain teeth have always been regarded as being the nearest approach to the ideal, both in form, color and strength, and in principle of attachment to the metal base, or to the root and while, perhaps, not universally applicable even now, still their use, whenever possible, affords a distinctive advantage over ordinary thin facings. At best, when compared with an all-porcelain crown, the latter are generally of poor form, are always of doubtful color because of the necessary use and close proximity of a metal backing and the consequent loss of transparency and translucency, and are manifestly weaker because of the presence of platinum pins as an integral part of the facings, and of their rigid attachment to the supporting structure by soldering.



The presence of platinum pins in thin facings, such as are now in general use, has always been recognized as an inherent element of weakness, and the heating and soldering process has been, and still must be, regarded as a more or less doubtful and sometimes even dangerous procedure. Both of these objectionable features may be overcome, however, by the use of detachable or replaceable crowns or facings, and their subsequent attachment to well-adapted and strongly assembled metal parts by means of cementation.

As such an attachment is equally secure and manifestly safer than the more rigid and unyielding one resulting from heating and soldering; as such crowns or facings are certainly stronger than those in which the porcelain is necessarily weakened by the presence of platinum pins, and as opportunity for replacement in the event of accident—a contingency which is possible whenever and wherever porcelain is subjected to stress—is always present and favorable, this type of construction must ultimately become more or less general, and will be found applicable to all cases of favorable occlusion, and for which suitable forms of porcelain crowns may be obtained.

With these combined advantages and possibilities the construction of crowns and bridges may be accomplished with a minimum display of metal and a maximum degree of strength; and, therefore, with all of the cosmetic and hygienic qualities, and none of the doubtful features of modern porcelain work.

Application to the Construction of Single Crowns.

In the application of the casting process to the construction of single crowns *two* general types will be found to meet the requirements in a very large percentage of cases.

As applied to the restoration of the ten anterior teeth or such teeth as are within the range of vision, or, in other words, where the cosmetic requirements demand the use of porcelain, the *detachable* or separable dowel crowns, such as the Davis, White, Justi, etc., with a thin well-adapted cast-base, offers the greatest possible field of usefulness, and the nearest approach to the ideal; while as applied to such teeth as are beyond the range of vision, or where the cosmetic requirements are secondary to those of inherent strength—both in the crown itself and in its attachment to the supporting root—no type of construction will, perhaps, ever take the place of a properly fitted and well-adapted gold crown.

Porcelain Crowns.

In the construction of porcelain crowns with cast bases, the requirements of root preparation are practically the same as indicated for any

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other type of construction, except, perhaps, that the labial or buccal surface should be trimmed a trifle shorter than the gum line in all cases, as a means of insuring the complete concealment of the metal base.

When no band is to be used, and one is seldom necessary because of the possibilities of obtaining absolute accuracy in the adaptation of the cast base, to both the *end* and *periphery* of the root—the removal of the remaining ledge of enamel is, of course, unnecessary. When the root is cut down to the required point, however, all of the advantages of a band may be obtained by simply rounding off the extreme angle with a large round bur, thereby permitting a thin edge of the wax to be molded over and around the basal end of the root.

When the preparation of the root has been completed, unless a large selection of crowns are at hand, a wax or modeling compound impression should be taken, from which a model should be made to be used only for the purpose of facilitating the selection of a crown of desired size, form and color.

The mounting of a temporary crown and the dismissal of the patient at this point will be found advantageous as a means of compressing the surrounding soft tissue, and of thus obtaining a free exposure of the end of the root; and also of affording *opportunity* for the subsequent selection of the crown.

This procedure will also be found particularly advantageous in those cases where the root is already badly broken down, as a result of accident, or as a sequel to decay and neglect, in which cases the casting process offers opportunities for obtaining an adaptation heretofore practically impossible.

Adaptation of Crown. A suitable selection of crowns should be ready when the patient next presents, and the one best adapted to the requirements of the case should be ground to the proper adjustment directly upon the root. In effecting this adjustment the labial or buccal surface of the crown should be ground to a close approximation with this surface of the root, observing that the proper length, occlusion, contact and alignment are obtained at the same time, without paying any special attention to the fit at the approximal and lingual aspects.

Adjusting Dowels. In all cases where the position of the root and size of the canal are normal the canal should be enlarged to accommodate the dowel, and the latter then cut to the exact length, which, when properly adjusted, will sustain the desired relation between crown and root.

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Where the size or malposition of the root, or the location of the canal in its relation to the crown present additional difficulties, or in cases where the use of more than one dowel becomes necessary, a thin base of platinum or pure gold should first be well adapted to the end of the root and the dowel, or dowels, soldered to it, in the manner subsequently to be described. The surplus ends of the dowels may afterward be cut off short enough to offer no obstruction to the proper adjustment of the crown or facing, and the crown may then be completed in the manner indicated.

Dowels. While the dowels composed of some of the German silver or nickel alloys which are made especially for the various types of crowns, and, hence, commonly used, will answer the purpose, it is doubtful if the metal to be cast will be as well alloyed with or attached to them in casting as to platinum, or to the alloys of iridio-platinum, clasp metal, etc. Therefore, the use of one of the latter is preferable, but ordinary round wire properly shaped and fitted will serve. Another objection to the former alloys first mentioned lies in the fact that they are more or less readily attacked by the acid used for cleaning, in consequence of which any class of work wherein such alloys are used must not be allowed to remain in the acid bath for too long a period of time.

When the dowel is made of round iridio-platinum wire, no size smaller than 14 gauge should usually be used, and this should then be tapered with a file until it corresponds with the dimensions of the root and canal, which are to accommodate it. Accurately fitting dowels, however, may be easily made by molding wax to the shape of the canal, or better still, by using a smaller wire—16 to 18 gauge—covering this with wax and then molding it to conform to the canal. This, of course, will be reproduced in casting the base, and such results will be found to be particularly applicable and extremely useful in many cases.

When such an adjustment has been obtained, the approximal and lingual surfaces of the crown should then be ground away until some little space exists at these points between its base and the root, as a means of admitting a sufficient quantity of wax to accommodate the end of the sprue wire, and of insuring a metal base of ample thickness and strength. The close joint around the labial or buccal surface, however, must be preserved as a means of precluding the unnecessary and objectionable display of any metal at this point (Fig. 412 A).

Where the base of the crown is much larger than the end of the root, which should be avoided when possible, its proportions should be reduced by grinding until it more or less closely approximates the size of the root.

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The extreme edge around these surfaces should then be nicely rounded in order that the wax base may be slightly overlapped upon the crown, thus more completely "boxing up" and better protecting the porcelain with the metal base (Fig. 412 B).

Molding Wax Base.

In molding the wax to conform to the end of the root and base of the crown, the *latter* should first be lightly coated with glycerine, liquid vaselin or thin oil, by means of a small brush or pledget of cotton, as a means of preventing the wax from sticking thereto. The dowel should now be placed in position in the crown and a sufficient

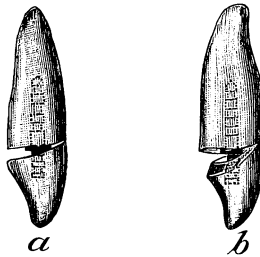


FIG. 412.

quantity of moderately soft wax then *melted* around it and over the surface of the porcelain until a quantity sufficient to a little more than fill the space between crown and root has been so placed.

In this procedure a somewhat softer wax than that indicated for fillings should be used, and it will always be found extremely advantageous to have it firmly attached to the dowel, and to have as little surplus as possible, for the reason that if the wax base should become detached from the dowel during or after molding it to crown and root it would be difficult to remove or handle, and also because every bit of unnecessary excess or surplus only packs in between the necks of the adjacent teeth and adds to the difficulty of removing it from the mouth.

The crown, with its wax base, should now be passed over the flame once or twice to slightly soften the wax, and then forced to place upon the root until the proper relation is obtained, when it should be chilled with a spray of cold water and then removed. The porcelain crown will usually be readily detached from the wax and dowel, and the latter can then be easily removed by grasping the end of the dowel with pliers.

When both parts are thus removed from the root they should be placed together again, out of the mouth, and all surplus then trimmed

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away with a warm, sharp instrument until a close proximity to the outline of the end of the root in the wax is reached, when the wax should be again chilled with cold water and the whole once more forced to place upon the root. At this time the small remaining surplus around the approximal and lingual surfaces should be carefully pushed up around the root and under the gum until a close adaptation, and the desired rim, or *band-like* effect, is obtained. The whole should then be chilled and removed—together, if possible—and the end of the sprue wire then warmed and securely attached to the thickest part of the wax base, with the crown in place, after which the porcelain should be removed and the case invested for casting (Fig. 413 A).



FIG. 413.

Thin Wax Bases. Where the extreme shortness of the crown precludes any considerable space between its base and the root without materially weakening the porcelain by undue grinding, and, hence, where the maximum thickness of wax is scarcely sufficient to afford accommodation for the attachment of the sprue-wire, an extension of wax may be carried over or overlapped upon the approximal surface of the crown to a sufficient extent to afford such opportunity (Fig. 413 B), and, after casting, this may be trimmed away in the finishing process.

Insuring Adaptation to Root. As a means of insuring a close, smooth adaptation to the end of the root a disk of platinum or of pure gold, about 36 or 38 gauge, may first be closely burnished, and then trimmed to the outline of the end of the root, perforated to accommodate the dowel, and subsequently soldered thereto with a small bit of high karat solder, and the wax base then molded to this and the gold cast directly upon it (Fig. 414 A). This procedure facilitates the molding of the wax and insures a close adaptation to the root, though it is necessary only in proportion as the character of wax or investment material used may not be properly manipulated, or may fall short of the ideal requirements.

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With Band.

In cases where the use of a narrow, well-fitted band may seem necessary or advantageous one may be used, and such a type of construction is frequently indicated, particularly in such cases as have previously been crowned with this style of crown, and, hence, where the root has already been prepared for a band, and, therefore, needs similar protection, or where it is to be used to support bridgework and, consequently, where every possible degree of strength in its attachment to the root is demanded.

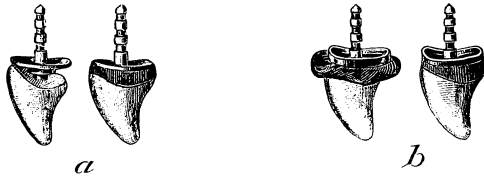


FIG. 414.

In such cases a narrow band of 30 or 32 gauge, 22 k. gold, or platinum, soldered with 22 k. or 20 k. solder, should first be carefully fitted to the root and then so trimmed as not to interfere with the proper adaptation of the crown, or to show upon the labial or buccal surface. When so fitted the crown should then be ground to place, the dowel adjusted, and the wax molded with the band in position on the root, as indicated. After molding the wax, removing the crown and wax base, and again assembling them out of the mouth, the band should then be detached from the root, placed in its proper position in the wax, and attached securely with a hot instrument. The surplus wax should now be trimmed down flush and even with the band and crown, and, since the band was made of a thin gauge metal, either 22 k. gold or platinum, if any reinforcement is wanted, the same may be accomplished easily by allowing a thin layer of wax to flow over the outer surface of the band, and especially over the joint which has previously been made with solder (Fig. 414 B).

The sprue-wire should now be securely attached at a favorable point, the porcelain removed, and the wax base with its band and dowel *in situ* carefully invested and subsequently cast. In casting it will be found that the metal cast will securely attach itself to both band and dowel, provided that both were *clean*, a precaution, however, which should always be observed; and the whole will constitute a strong, well-adapted base.

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Use of Ordinary Facings.

While the use of the various forms of detachable or separable dowel crowns is undoubtedly productive of the most artistic achievements, and affords opportunity for combining with these the advantages of strength and replacement, the casting process, however, is equally applicable to the ordinary type of facing, such as is commonly used in the construction of the various forms of porcelain-face, metal-back, or so-called "Richmond" crowns. Indeed, in cases where an extremely long overlapping of the crown upon the opposing natural teeth demands a *long* and *very thin* facing, the use of any other thicker or more bulky form of porcelain tooth may be precluded.

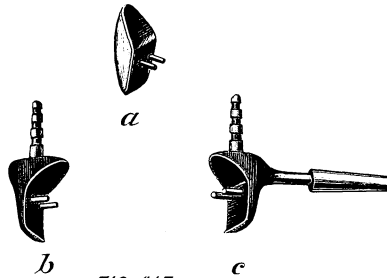


FIG. 415.

In their use, where the root has been properly prepared, one which will meet the requirements of the case should be selected and ground to its proper adjustment in the mouth. When this has been accomplished it should be observed that the pins are not too long, nor long enough to interfere with the opposing teeth; are parallel with each other, and at right angles with the facing. A backing of pure gold from 34 to 36 gauge should then be perforated, slipped over the pins, and closely burnished to the facing, allowing a *very slight* surplus to project beyond the porcelain upon all surfaces (Fig. 415 A). The pins which have probably been somewhat shortened, should now be coated with vaseline or oil, and the backing attached to the facing by running a little melted wax over it and around the pins.

The dowel should now be fitted and placed in position in the root—and the band, also, if one is to be used—and a small quantity of soft wax warmed and molded over the end of the dowel and base of the root. The facing and its backing should now be gently forced to place in the wax. When the proper adjustment has been obtained and secured with a warm instrument, the wax should be chilled, and the whole removed and trimmed up to the desired shape and form, then again tried to place to insure the relation and adaptation of facing, wax and dowel to root.

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When this is satisfactory the facing should be gently detached from the backing, by inserting a small-pointed instrument between them and lifted off. Small pieces of graphite points, of a size corresponding with, or very slightly larger, than the pins, which are made for vest-pocket pencils, and which may be procured at any stationer's, should now be forced through the holes in the gold backing and into the wax (Fig. 415 B), the sprue-wire attached (Fig. 415 C), and the case then invested and cast.

The presence of the thin gold backing, subsequently reinforced by, and thus becoming a part of the casting, will insure a smoother surface presenting toward the facing than would, perhaps, be obtained in the surface of the gold which is cast, because this is usually rough in proportion as the investment material is porous, or of coarse texture. The graphite pins will preserve the holes and may be subsequently removed therefrom by boiling in acid, or with a small round bur of the same size. When this has been done the facing should be placed in position and the crown then finished to the point of polishing. The facing should now be removed and the pins threaded with a Bryant "tap" designed for this purpose, and to be used in connection with replacing broken facings; or notched with a file, after which it should be cemented to place, using a cement which in color approximates that of the facing as nearly as possible, and which should be allowed to crystallize thoroughly before the crown is finally polished.

The same detail is also applicable to the use of **Detachable Facings.** the "Steele" detachable facings, or to any of the other similar forms of *thin* facings, one of which has been suggested by the author, and will be described later in connection with bridgework, but which is also equally applicable to single crownwork.

Whenever any replaceable type of crown or **Duplicates.** facing is used, however, the greatest possible advantages are to be obtained by selecting and grinding duplicates of all teeth at the time the work is being constructed. When this procedure is to be observed the crowns or facings which are to be used at the time should first be ground to the proper adaptation, and the backing for them then made, after which the duplicates should be ground to fit the backing. While the latter is not always a simple proposition, it may be greatly facilitated by painting the surface of porcelain with black oil paint, such as comes in small tubes for artist's use. Articulating or carbon paper, or typewriter ribbon, may also be used for this purpose, although the first-mentioned method will be found preferable. When the duplicates are thus ground to fit the backings made for the originals

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they should be placed in a small box, properly labeled, and preserved for future use in case of accident.

In any event the manufacturer's formula, or the mold number and color number, should always be obtained and entered upon the record as a means of enabling the operator to replace any particular tooth or facing at any time, or to communicate such information as will enable any one else to likewise serve the patient.

Wherever it may for any reason seem advantageous, or necessary, to make models, and to obtain the proper adjustment and molding of wax upon them, rather than in the mouth, accuracy may be attained by first carefully and closely adapting a disk of thin pure gold or platinum, 34 to 38 gauge, to the end of the root or roots, subsequently attaching this to the dowel with a small bit of 22 k. or 20 k. solder, and with this in position then taking the impression with plaster. After removing the impression it should be observed that the disk and dowel are in their correct position therein, after which the entire length of the latter should be covered with a very thin coating of soft wax in order to facilitate subsequent removal from the model. This may be done to good advantage by melting the wax and painting it on with a small brush. When the model has been made of plaster, or a good investment material, the thin disk and dowel should be slightly warmed, then gently detached, removed and cleaned in the acid bath, after which it may be replaced, and the work of adjustment and molding of wax done thereon.

A more or less accurate model may also be made by first molding a small quantity of wax to the end of the root, with the dowel in place—and with the band also if one is used—and then taking the impression over this with plaster. With these in their proper place in the impression, when the model is obtained and the wax gently and carefully removed, a good smooth outline of the end of the root will usually present. The band, if one has been made, and the dowel should first be detached and cleaned in acid, and the model then varnished and oiled, after which the proper adjustment of the parts, and the molding and carving of the wax may be accomplished with facility and reasonable accuracy.

Casting against Porcelain.

While the removal of the porcelain crown or facing from the wax prior to investing and casting, and its subsequent attachment to the metal by means of cementation, possesses indisputable advantages, some, however, may prefer to include the porcelain in the investment, and cast directly to it. This may be done easily since such a procedure involves only a question of heat, and this demands that the investment and porcelain be heated to a very red heat before, and remain at this tem-

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perature at the time of casting. If this be carefully done any of the metals or alloys used in casting, and favorable to the requirements, may be cast directly to the porcelain, which will thus become an integral part of the piece, and two, or even more, facings or crowns may be included in the same casting, provided, also, that sufficient space exists between them to allow for a probable shrinkage of the metal in cooling.

The only supposed advantage to be derived from this procedure, however, lies in the fact that subsequent cementation of the porcelain to the metal is, of course, unnecessary, but instead of this being an advantage, it is regarded as a disadvantage, and the procedure, at best, is always fraught with uncertainty and danger, especially when the high fusing metals are used.

It is to be so regarded because the porcelain is thus unnecessarily subjected to a high degree of heat, the intensity of which always, at least, endangers the integrity and color; because the porcelain is attached in a more rigid and unyielding manner, and thus more likely to break under the stress of occlusion, and because no opportunity for replacement in the event of fracture presents.

Advantages of Cementation.

The elimination of all of these possibilities constitutes the very advantages obtained in the use of replaceable teeth cemented to place on the metal structure. For, since by means of casting it is now possible to obtain an adaptation of the metal to the porcelain which insures accuracy and uniform strength; and since attachment by means of cementation is conceded to be reliable in proportion as the adaptation is close; and as such attachment is undoubtedly stronger; when these are considered together with the further facts that the porcelain is not subjected to any degree of heat; that it is not held so rigidly and is, therefore, *less likely* to break; that its color is never changed and that replacement is always possible, the advantages must necessarily be regarded as unquestionable. It would, therefore, seem that this method of procedure is destined to be the more or less general practice of the future.

Gold Crowns.

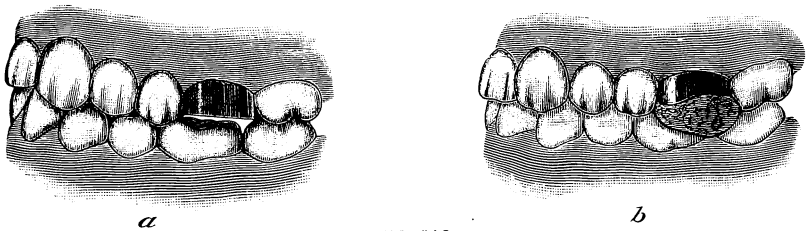
The application of the casting process to the construction of gold shell or telescope crowns also offers many advantageous features. By this means the taking of impressions, the making of models and dies, and the necessity for swaging and soldering become unnecessary; all of the combined advantages of the *solid-cusp*, *sectional* and *seamless* methods are possible, and may be accomplished in less than, or approximately half of, the time previously consumed; and *better fitting*, stronger and

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even more artistic results are obtainable in proportion as the operator's skill and knowledge of tooth form may be developed.

Construction. In the construction of this type of crown by casting two general lines of procedure may be followed, but these differ only in the width of band fitted to the root, and the manner of obtaining form and contour to meet the requirements of alignment, contact and artistic effect, the occlusion being obtained in the same manner in both.

Because of the difficulty of obtaining a good close adaptation to the root around its entire circumference, and within the free margin of the gum, with so plastic a substance as wax, alone and unsupported, the use



of a band is absolutely necessary, and while some may prefer to use a narrow one and secure the desired and required shape and contour with wax, rather than to use a wide one and first shape it to comply with these requirements, the best and most uniform results are usually to be obtained by the latter method.

In the procedure which is regarded as being the most simple and expeditious, and at the same time productive of the best results, a band of 28 or 29 gauge, 22 k. gold, should be cut in the usual manner, soldered with 22 or 20 k. solder, trimmed to follow the cervical curvature of the gum, and fitted to the root, which should be prepared in the usual manner, at a point just within the free margin. When this has been accomplished it should then be contoured to conform to the buccal and lingual alignment of, and to restore contact with, the adjacent teeth, and the occlusal edge then trimmed until just free of the opposing teeth when occluded; and then filed smooth, after which it should be placed in position upon the root (Fig. 416 A).

A piece of hard wax, such as is used for inlays, should now be trimmed to such size as will fit into and fill the entire inside of the band and liberally accommodate the occlusion. When so trimmed this should

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be heated in water of the proper temperature, and then forced into the band against the end of the root and over and around the entire edge.

The patient should now be instructed to close firmly into the wax, and then to indulge in the various movements of mastication in order that all such movements may be freely accommodated (Fig. 416 B).

When this has been satisfactorily accomplished, a pointed instrument should be inserted under the cervical edge of the band, and the whole detached from the root. The interior of the band should now be carefully filled with the same investment material to be used in casting



FIG. 417.

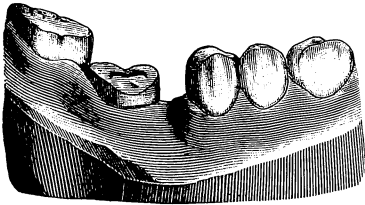


FIG. 418. A.

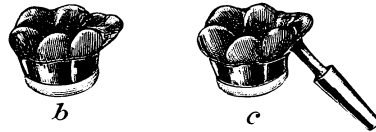


FIG. 418. B.

in order that the relation of the wax to the band may be securely sustained while carving (Fig. 417 A). As soon as this has crystallized the surplus wax should be trimmed away until even and flush with the band, and the occlusal surface then carved in such manner as to preserve several points of occlusion, and at the same time round off all high interlocking points and typify the tooth (Fig. 417 B).

In those cases where a slight space exists as a result of the premature loss of a tooth (Fig. 418 A). the crown may be found in such manner as to afford an uninterrupted occlusal surface by simply allowing the wax to extend over into this space and subsequently carving it to meet such a requirement (Fig. 418 B).

Any additional reinforcing or contouring of the band may now be made by flowing wax over it at such places, and as the joint has been made with solder which very probably fuses much lower than the gold, of which the cusps are to be cast, it is always well to reinforce this with wax in order to preclude the possibility of its becoming opened in casting.

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The sprue-wire should now be attached (Fig. 418 C), and the crown then submerged in water until the investment material inside of the band becomes saturated as a means of insuring a close union between it and the fresh matrix to be used, and then the investment for casting completed.

Where a gold band is used in this manner it is necessary, of course, that a grade of gold similar to that of which the band is made should be used for casting the cusps in order that a uniform color may prevail throughout the finished crown. Scrap gold, however, even though it contains some solder, may be used for this purpose if melted and refined

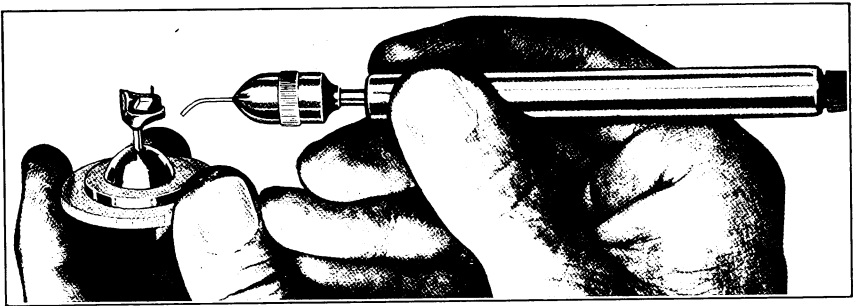


FIG. 419.

with saltpeter and borax on a charcoal block previous to casting. Indeed, the presence or addition of a small proportion of solder so reduces the fusing point as to preclude burning the band, and increases the flowing properties to an extent which insures a good physical union.

Short Roots. In cases where the supporting root is very short and, hence, where the occlusal surface of the crown would necessarily need to be extremely thick in order to fill the entire space between the end of the root and the cusps of the opposing teeth when in occlusion, and thus make the weight of the finished crown objectionable, or the cost possibly prohibitive, either one of two procedures may be used to advantage.

First, the root may be built up with amalgam or cement to approximate the length of the band, and thus diminish the thickness of the cusps; or, second, the unnecessary thickness of the wax forming the cusps may be reduced to a minimum by the use of the wax "suction carver," designed by Dr. F. E. Roach, of Chicago (Fig. 419). This is a most ingenious little contrivance and will be found almost indispensable in all forms of wax work. When used in this connection the thickness of the wax cusps should be diminished immediately after removing the crown

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from the mouth, and before the interior of the band is filled with investment material as recommended, but care should be observed to preserve enough of the shoulder of wax which is adapted to, and rests upon, the end of the root to prevent losing the very great advantage of having the finished crown set solidly thereon (Fig. 420).



FIG. 420.

Indeed, this is one of the paramount advantages obtained by this method, and explains the statement previously made to the effect that a better fitting crown is thus possible for the reason that crowns so made go to place on the roots much as an inlay does in a cavity; it is impossible to force them too far down, and, hence, less discomfiture follows after mounting, and a minimum quantity of cement is required to insure a maximum of strength in the attachment of crown to root.



FIG. 421.

In constructing a crown where a narrow band is used in preference to a wide one, the cervical end of the band must, of course, be fitted to the root with the same care and precision, but a thinner gauge of either 22 k gold or platinum may be used. A thickness varying from 30 to 32 gauge will answer the purpose nicely, since it is used only to insure the correct cervical adaptation, and is to have its outer surface entirely covered over with wax and subsequently with gold.

When properly fitted and burnished to a close proximity with the axial surfaces of the root, quite a large piece of wax should be trimmed to proper shape, heated and then molded over root and band and accommodated to the occlusion. When this has been accomplished the wax should be chilled and the whole removed. If the band is not removed with the wax it should be detached from the root, carefully placed in its proper position in the wax, and sealed with a hot instrument. The entire

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crown may now be shaped and carved to meet the requirements of alignment, contact and occlusion, in which the outer surface of the band should be completely covered with the melted wax, allowing it to taper down until only the extreme cervical edge is exposed (Fig. 421 A).

A method quite similar, but varying in detail in so far as the width of band is concerned, is recommended by Dr. C. E. Meerhoff, of Chicago. In this procedure the band is made somewhat wider, and in fitting is allowed to project a short distance beyond or above the basal end of the root. This projecting edge is then slit around its entire circumference, and each flap bent over until it rests upon the end of the root (Fig. 421 B), after which the wax is molded and carved and the crown completed in the same manner. If any advantage is possessed by this method it lies mainly in the fact that the cap thus made is held more firmly in its relation to the wax than is a simple band, and, hence, any possible displacement during the process of carving is overcome.

While all of this carving may be done at the chair and the crown tried in from time to time until the desired artistic results obtain, some may prefer, or may feel that they work to better advantage on models. In this event the usual bite and impression should be taken with the band in position on the root and a plaster model made and the case mounted upon the articulator. When separated the band should first be carefully detached from the model, cleaned in acid and replaced, after which the models should be coated with shellac varnish, followed with glycerine or oil to prevent the wax from adhering thereto and the wax then molded and carved thereon.

Since reproductions, however, no matter how carefully they may be made, are rarely ever as accurate as the original, the use of models is not recommended as a general practice and should be resorted to only when absolutely necessary.

Indeed, one of the beautiful features and one of the greatest advantages offered by the casting process is the very fact that so much of the work which was formerly confined exclusively to models may now be done directly in the mouth, and whenever possible this undoubtedly insures greater accuracy than models of any kind, for any purpose.

(To be continued.)



A Consideration of the Temporo-Mandibular Region.

By S. MERRILL WEEKS, D.D.S., Philadelphia.

Read before the American Society of Orthodontists, Washington, 1908.

The subject to which I am now asking your consideration is one which I believe should receive more careful thought not only among those who are specializing in orthodontia, but among all members of the medical and dental professions.

Thus far it has received but enough attention to show that there is a wide difference of opinion, or no opinion at all, among the members of the dental profession.

So far as I have been able to ascertain, the attention was first directed to the subject by Dr. Kingsley not far from the year 1870. At this time he calls attention to the treatment of two cases, one of Class II, Div. I, and another Class III. Regarding these cases he speaks of changing the position of the condyle in the glenoid cavity.

These observations of Dr. Kingsley's do not seem to have made a profound impression on the minds of the dental profession. I have been unable to find other references made to the matter, or a concurrence of opinion among dentists.

Within the last year or two Dr. Howe, of Boston, has presented to the profession the reports of several cases, the treatment of which, to his mind, involved changes in the temporo-mandibular articulation. More recently Dr. McDonald, of Chicago, in an article in the *American Dental Journal* calls attention to the changes in the glenoid fossa during its pro-

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gressive stages of development. At the present moment I know there are members of our profession who hold pronounced and widely varying opinions on the subject. While this condition of judgment exists I contend that a careful and earnest presentation of facts relative to this articulation and a similar discussion of the same will be useful to our members.

The importance of reaching correct conclusions in the relation between tooth movements and this joint can be doubted by no one. It is important from several aspects in determining the etiology of those cases denoted as Class II and Class III, in which the relation of the teeth of the lower arch to the upper is either mesial or distal to normal.

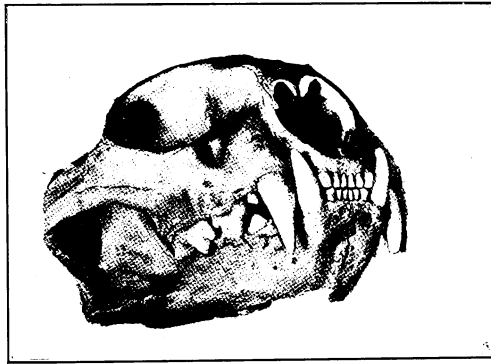


FIG. 1.

Fig. 1.—Showing the occlusion which is responsible for the peculiar joints of the carnivorous.

At present there is a radical difference of opinion as to the etiology, some contending that this abnormal relation is accounted for by an abnormal relation between the (teeth and alveolar) process and the mandible itself, while others are equally positive that the change from normal has taken place in the temporo-mandibular articulation.

Again, it is most important in the consideration of the facial aspects as associated with and influenced by the dental relation existing in the two classes of cases referred to.

If we preclude the possibility of any deviation in this joint we must conclude that so far as the lower portion of the chin is concerned there can be but slight variation from the normal in the profile.

Another phase which we must consider as most important is that of the correction of the abnormalities contained in these two classes.

The treatment and the results obtained are widely divergent, depending upon the position from which we view these cases.

In the consideration of this question it is necessary to have a clear conception of the parts concerned in this joint and their relation to each other, both in their action in performing their function of mastication, and in their relation during the different stages of development.

Joints in general anatomy are developed and the final character determined by the kind of motion which has been indulged in through the life history of the animal in question. Furthermore, the anatomy of the joint undergoes changes in development as the motion undergoes changes in the life of the animal.

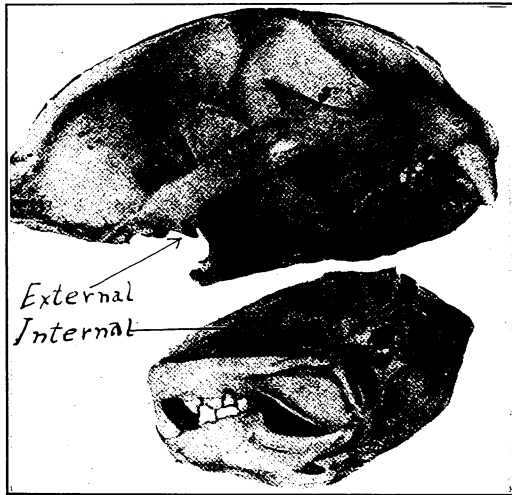


FIG. 2.

Fig. 2.—Showing the two views of the temporo-mandibular articulation of the carnivorous.

The temporo-mandibular articulation is capable of, perhaps, the greatest variety of movements of any of the articulations, and has a great many variations in the different animals, being dependent upon their habits and customs in acquiring and masticating their food.

A consideration of many of these classes and individuals, showing how the joints are influenced and determined by the habits and customs would not only be interesting, but instructive. However, the time in this case will not permit, and I shall have to content myself with a few typical and interesting examples.

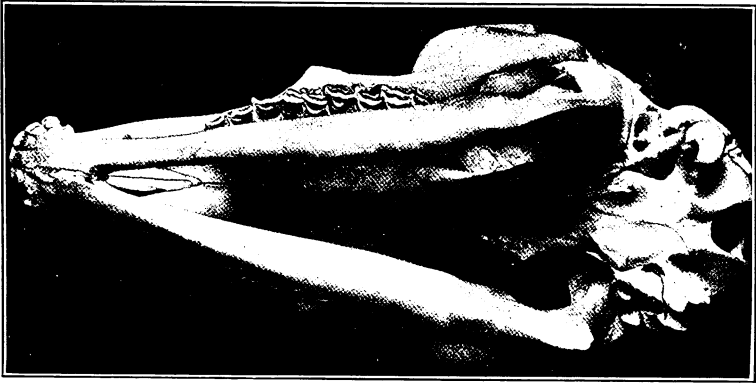


FIG. 3.

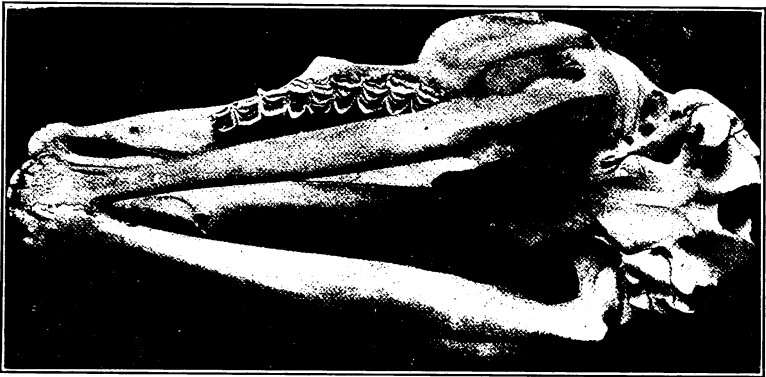


FIG. 4.

Figs. 3 and 4.—Showing the occlusion and temporo-mandibular articulation of the herbivorous.

Taking the three great classes of animals, the carnivorous, herbivorous and omnivorous, we shall see that the carnivorous is capable of the least motion ; this because of the character of the food and the teeth that are supplied to prepare it for assimilation. As an example of the carnivorous we will consider the masticating mechanism of a tiger. You will see that the occlusion of this animal would preclude the possibility of any, or of but very slight lateral motion, and that the joint is developed in a manner compatible with those conditions. Other carnivorous animals present these conditions in varying degrees.

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The herbivorous present just the reverse conditions, inasmuch as the food is of a different nature and the teeth of a different character, requiring more of a grinding or lateral motion to complete mastication. Here we find the joint instead of being simply of the hinge variety, as in the carnivorous, is more of a ball and socket variety giving a large variety of movements. Of this class the sheep presents about the best example. Another animal which presents very interesting features is the muskrat. This animal, which belongs to a large class of rodents, has very pronounced characteristics, due to the fact that the joint is called upon to



FIG. 5.

FIG. 6.

FIG. 7.

Fig. 5.—Showing the occlusion of the muskrat. The two dots in the glenoid showing the different positions of the condyle, the one during the act of incision, the other during the act of mastication.

Fig. 6.—Showing the position during mastication.

Fig. 7.—Showing the position during the act of incision.

perform acts of a widely varying nature. Thus we have a glenoid fossa developed along special lines to meet certain peculiarities of the animal. The act of incision is highly specialized, and for this the joint is developed to meet the necessity. The act of mastication requires a complete change in position of the mandible. It will be seen that to meet these different conditions the glenoid cavity is developed over a comparatively large area, each part designed to perform a different function.

Of the omnivorous class the genus homo will be the best and most pertinent for us to consider.

In the consideration of the temporo-mandibular articulation of man it will be my purpose to take up the different parts in detail considering the osseous structure first.

Temporo-Mandibular Articulation of Man.

Of the condyle I shall say but little as I have been able to find but

little deviation; insufficient to influence the classes of abnormalities that we have under consideration

Dr. Broomell speaks of it as varying with temperaments. In any case they are very similar and change but little in general character during development, except to assume larger proportions.

In the glenoid fossa we find conditions much different, and it is here



FIG. 8.

Fig. 8.—Showing the temporo-mandibular articulation of a child of four years. Note the indefinite character of the glenoid fossa.

that I think we may find the key to the solution of our problem. As I have shown, the glenoid fossa is subject to many variations in different creatures; it also varies largely in the human anatomy.

The anterior part, the *eminentia articularis*, is formed by the anterior root of the zygomatic process, and is the most prominent portion of the fossa; from this point the fossa curves backward and upward to form the deepest portion of the fossa; from here the curve is downward slightly to the glenoid fissure; this divides the fossa in two portions; back of this is the tympanic plate which forms the osseous division between the posterior portion of the glenoid fossa and the auditory meatus.

The fossa is subject to considerable changes during development. The law of these changes can have no better expression than the example given us by Dr. Cryer in his "Anatomy of the Face":

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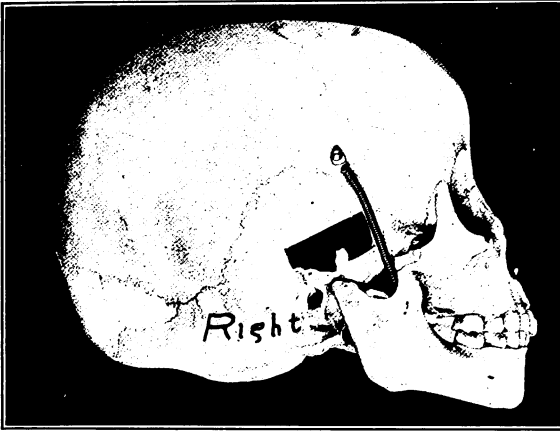


FIG. 9.

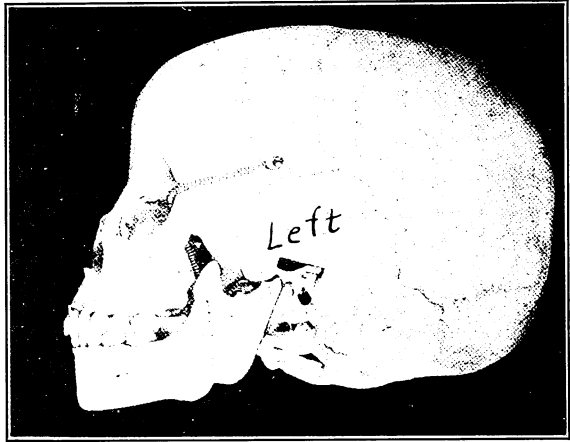


FIG. 10.

Figs. 9 and 10.—Show the glenoid cavity and the condyle cut open antero-posteriorly. It will be seen that the occlusion of the teeth on the right side is distal to normal and that the condyle has assumed a more posterior position in the glenoid fossa, while on the left side the teeth are in normal relation and the condyle rests normally on the incline of the glenoid fossa.

“If these two forces be normal—that is, properly balanced—in potential strength and application throughout life, the result will be a normally developed organism; but if these forces be interfered with in any way, by lack of nourishment or undue external pressure, the individual may fail to develop a normal physique.” (“Causes of Variations in

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Shape," page 141, paragraph 2.) And again, "The normal application of the forces affecting developing bone results in normal development of the form of the bone. Their abnormal application under the same circumstances results in the development of abnormally formed bone. Abnormal application of forces to the bone in adult life will also change and modify the shape and character of the bone tissue."



FIG. II.

Fig. II.—Shows the right side of the temporo-mandibular articulation in which the distal portion of the condyle is directly or nearly in contact with the tympanic plate of the temporal bone.

At birth there is but little definition, the *eminencia articularis* and the deepest portions of the fossa presenting but a slightly curved line. From this time on the development is peculiarly influenced by the position of the condyle, while the position of the condyle would seem to be influenced by the occlusion of the teeth, muscular relations, habits, etc.

I believe that the development of the osseous structure of the glenoid fossa is determined along the lines of the least resistance, and as the greatest resistance would be at the point of contact of the condyle, we would have developed here the bone of a more dense character, while at the other position away from the point of extreme pressure, we would



FIG. 15.

Figs. 15 and 16.—Show how the occlusion of the teeth may be responsible for abnormalities in the formation of the temporo-mandibular articulation. It will be seen that on one side the occlusion of the teeth has been such as to allow for a considerable amount of lateral motion, thus causing the glenoid fossa to be large and indefinite in nature, while on the other side the occlusion has been more definite, causing the temporo-mandibular articulation to form in a definite manner, as is usual with subjects of advanced years.



FIG. 16.



FIG. 12.



FIG. 13.

FIG. 14.

Fig. 12.—Shows a different view of the same condition.

Figs. 13 and 14.—Show cross-section of the temporo-mandibular articulation in which, when the teeth are in normal occlusion, the condyle rests considerably anterior to the deepest portion of the glenoid fossa.

have bone of greater bulk, but of less density. In this way it would seem that the development of the glenoid cavity is dependent upon the position of the mandible.

I wish to ask here your particular attention to a consideration of the articulating cartilages, which, I believe, are of even *more* importance in determining the position of the condyle. Of these there are two varieties; the hyaline type covers and is attached to the articulating surfaces

of the joint. The other surface is covered with a fibrous membrane which in turn is covered with the synovial fluid. This cartilage is of a general nature and undergoes no great change during the development to maturity and old age except, perhaps, to become thinner and more dense. The character varies but slightly, if any, over the entire surface. This, therefore, we may put down as invariable.

Interposed between these surfaces we find the interarticular fibro cartilage. Between it and the cartilage covering the articulating surfaces

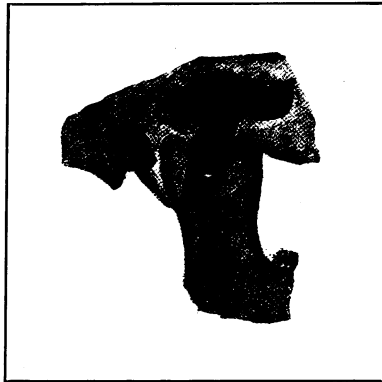


FIG. 17.

No. 17.—Shows diagrammatically how the inter-articular cartilage acts to help sustain the condyle along the upward incline of the glenoid fossa.

of the bone on either side we have a sac containing the synovial fluid. The interarticular cartilage has its attachment at its boundary to the capsular ligaments.

The character of this interarticular cartilage is varied. In childhood it is thick and yielding, which would make it easily susceptible to influences; on the one hand existing to guide it to assume normal relations; on the other, requiring but little to cause the condyle to rest in a malposition in the glenoid fossa.

It will be noticed that the condyle in normal cases does not rest as we might expect it to, in the deepest portion of the glenoid fossa, but at some point along the incline toward the *eminentia articularis*, the point doubtless being determined by such factors as the occlusion, condition of the ligaments and muscles.

The fact that it may be retained in this position must be accounted for

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in part by the varying thicknesses of the interarticular cartilage, these varying thicknesses being established by the pressure of the condyle; being the thinnest at such point as the pressure is continued for the greatest length of time.

The capsular ligament is doubtless another factor in sustaining the condyle in its position on the upward incline of the fossa inasmuch as the posterior portion has its attachment above the glenoid fissure, and with some portions of the parotid gland, occupies the space between the posterior part of the condyle and the tympanic plate. However, during the formative period of this joint all of these soft tissues would be easily subject to outside conditions.

That the joint may be influenced by external conditions during maturity can be shown by the examination of skulls showing a considerable variation in the shape of the fossa and in the amount of motion, of which the condyle would be capable.

With these factors in mind, and in conclusion, I wish to ask your consideration of these points:

First. That the relation of the parts concerned in the formation of the temporo-mandibular articulation is of such an indefinite nature as to afford the point most easily influenced by the abnormal relation in occlusion, in habits, in mouth-breathing and in traumatisms, etc.

Second. That the deviations in facial lines are of such a nature as to be accounted for only by malrelations of the mandible as a whole.

Third. That in the correction of these malformations we fail very greatly in producing the best results if we disregard the possibility of changing the mandible as a whole, because the movement of the teeth and alveolar process alone will produce almost no change in the point of the chin, where there is the greatest need of improvement.

Discussion of Paper by Dr. Weeks.

It gives me much pleasure to open this discussion on "A Consideration of the Temporo-Mandibular Region," and through the permission of your officers and Dr. Weeks, I will introduce a few other points not alluded to by the essayist. It has been said by a high official of one of the great universities that what is wanted in the President of the United States is a man who will think before he acts. I agree with him, and wish to say that an orthodontist, as well as any other man, should think before he acts; without this attribute the orthodontist will do more harm to the individual patient than a President can do to the United States. When

I wrote the paper on "Typical and Atypical Occlusion of the Teeth in Relation to the Correction of Irregularities," it seemed that sufficient consideration was not being given to the various anatomical, physiological and pathological conditions, and also to the general health of the patient. I was glad to find that the discussion of the paper not only proved that there were thinking men who were interested in scientifically correcting irregularities of the teeth, but it also proved that there were others who did not "see all around the circle" of this important subject—those who thought part way and jumped at conclusions for the remainder.

In discussing the question of a consideration of the temporo-mandibular region it is, of course, necessary to consider the relation of the mandible to one of the most important bones of the cranium—the temporal. This bone forms a portion of the base of the brain case; it contains a canal through which the carotid artery passes to supply the greater portion of the brain and the eye. In the posterior portion of the bone is a great groove for the lateral sinus, which accommodates the outflow of blood. The nerve of facial expression passes out through a tortuous canal in the temporal bone. The organ of the special sense of hearing is located in close juxtaposition to the condyle of the mandible. The mandible is formed from Meckel's cartilage, from which the ear bones develop; in fact it is a continuation of the malleus in early embryonic life.

From the data shown by Dr. Weeks, and others to which I shall direct your attention, will be demonstrated the necessity of considering the structures associated with the temporo-mandibular articulation, before undertaking to change the relations of the two bones entering into it. You will see at once that I am committed to a belief in the affirmative of the main question before us, as to the possibility of changing the relations of the bones entering into the temporo-mandibular articulation; but, while accepting the general truth of that fact, I wish to be clearly understood as to my position with regard to the limitations, which, in my own judgment, qualify the extent to which such changes of relation may conservatively proceed. A forward placement of the jaw, I think, can be accomplished with less risk than a backward placement. Slides made from specimens will be shown in which the tympanic wall has not been formed, and others where it has been lost through disease. In such cases a retro-placement of the mandible by any of the mechanical orthodontic means known to me, would, in my opinion, be attended with serious risk to the life of the patient. If all skulls were typically normal, there would be no necessity for orthodontists of any school—not even of the "new school," except in case of accident, as in such skulls the teeth are in

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typical positions. But, fortunately for the orthodontist, many skulls are not typical, and as a general rule the teeth are not in typical, nor in functionally correct positions. If this be accepted, and we wish to bring about changes, it stands to reason that we must deal with problems that go further back than the question of the positions of the teeth, in order to correct them judiciously. We must go back to embryonic life, and study the various phases from that time onward.

The author of the paper has drawn our particular attention to the temporo-mandibular articulation. Therefore, in justice to him, we will endeavor to keep close to a study of that region. He has shown us the anatomical condition of this articulation at the time of birth and at other periods; also, some comparative anatomy. When asked to discuss this paper, and I was told by the chairman of the Executive Committee to bring all the slides I wished. I made a selection of a number of skulls, and have made slides from them. They include skulls of individuals from the time of, or before, birth, up to old age, and also a few of the lower animals.

In the mammalian the articular surface of the condyloid process of the mandible is convex; in all other vertebrates it is concave, articulating with the convex surface of what corresponds to the glenoid cavity in mammals. The portion of the skull with which the mammalian mandible articulates—the glenoid cavity—is generally concave, as in man, though there are great variations. In the rodents it is groove-like antero-posteriorly. In the hog, and animals closely related to it, the condyle articulates upon the *eminencia articularis* instead of in the glenoid cavity. If the temporo-mandibular articulation of the vertebrate be shown to one who has paid any attention to the occlusion of the teeth in relation to this joint, he can readily tell the character of the teeth, and the nature of their occlusion. Conversely, given the occlusion of the teeth, he will be able to classify the animal and give the character of the temporo-mandibular articulation.

At one period of life the articulations of the vertebrates are very similar to each other. As life advances the similarity disappears, conditions changing in proportion to the environment and character of the food. If the articulation of the mammalian type alone be studied great variations will be found. Time will only permit mention of a few. Slides of the human subject will demonstrate how flat the glenoid cavity is about the time of birth, and that there is but little change until the time arrives for the child to eat meat; then it changes rapidly until puberty. As old age comes on the articulation again changes and becomes more like that of childhood. In the ruminant animal the glenoid

Changes in Articulation of the Mandible.

fossa at birth is flat, and deepens but slightly with advancing life. In the carnivora, the glenoid cavity at birth is comparatively flat, but begins to deepen early as the animal soon becomes a meat-eater. In the omnivora this cavity changes in relation to the character and food eaten. In those animals living entirely on meat the glenoid fossa is deepest, and the anterior and middle roots of the zygoma grasp closely more than half way round the condyles of the mandible, rendering it impossible to disarticulate the bone.

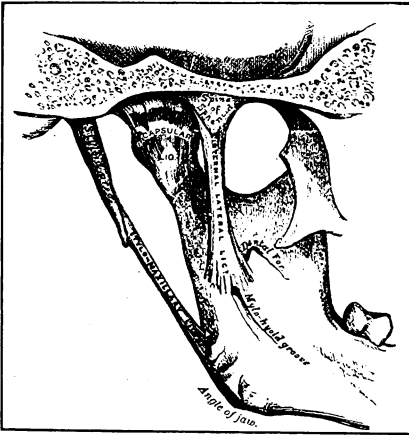


FIG. 1.

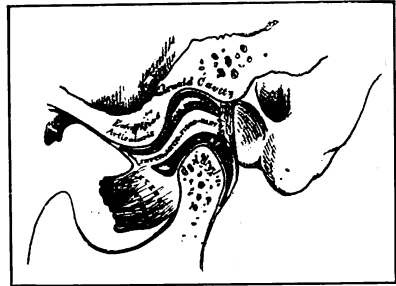


FIG. 2.

With this introduction we will take up the slides for a more graphic portrayal of the many adaptations of the temporo-mandibular articulation to the varied functions it is called upon to perform in relation to the food habit of the individual.

Those who wish to prepare themselves for any special work in medicine or surgery, are usually compelled to commence again the study of special anatomy, physiology and pathology. For the reason that many teachers of these branches are not practical men, and the books on these subjects are too often written by men who do not practice, they run into ruts and follow each other blindly, often without doing any original research. Take, for example, the illustrations Figs. 1 and 2, taken from "Gray's Anatomy," of the Temporo-Mandibular Articulation, now under discussion. They show erroneous anatomy and are misleading, if the student is not made to understand they are, at best, nothing more than diagrams, and when thus studied become useful. These two figures give a general outline of the articulation, the bones, the ligaments, etc.; but

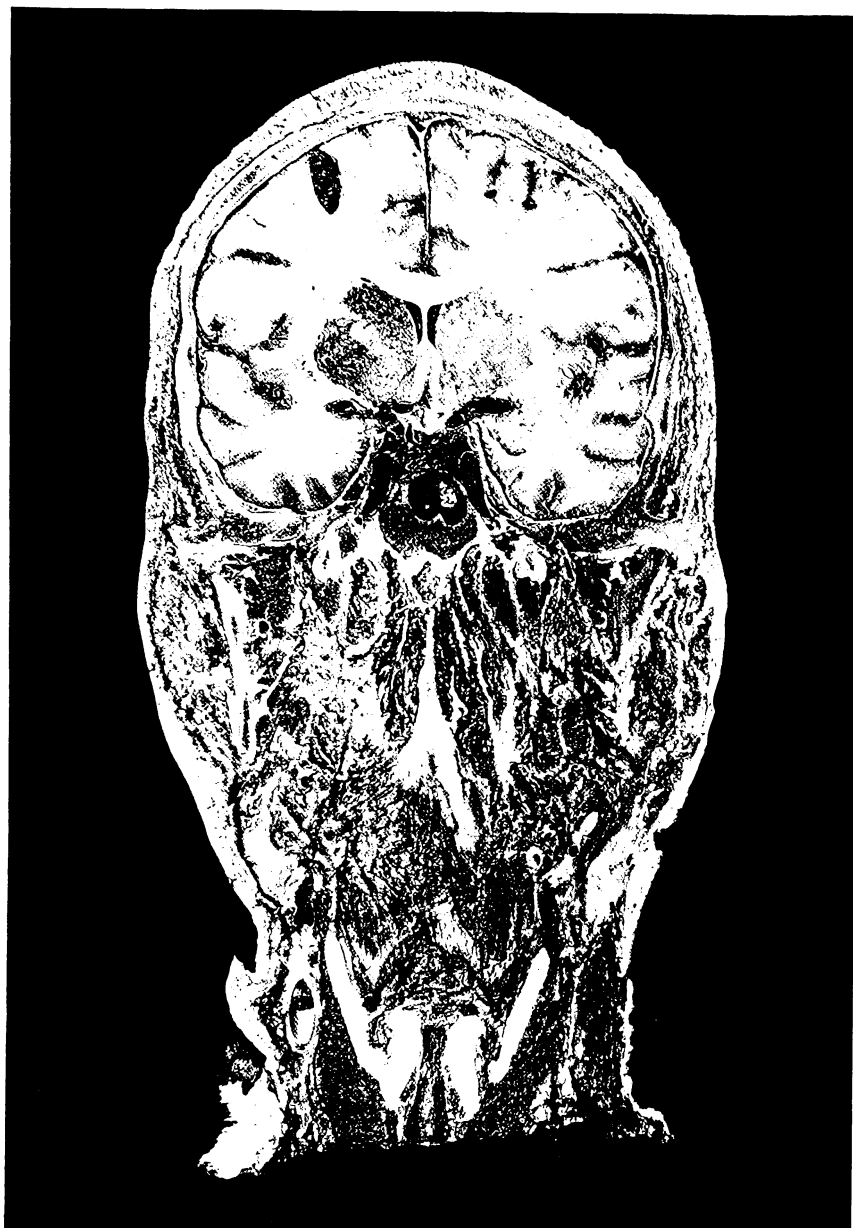


FIG. 3.

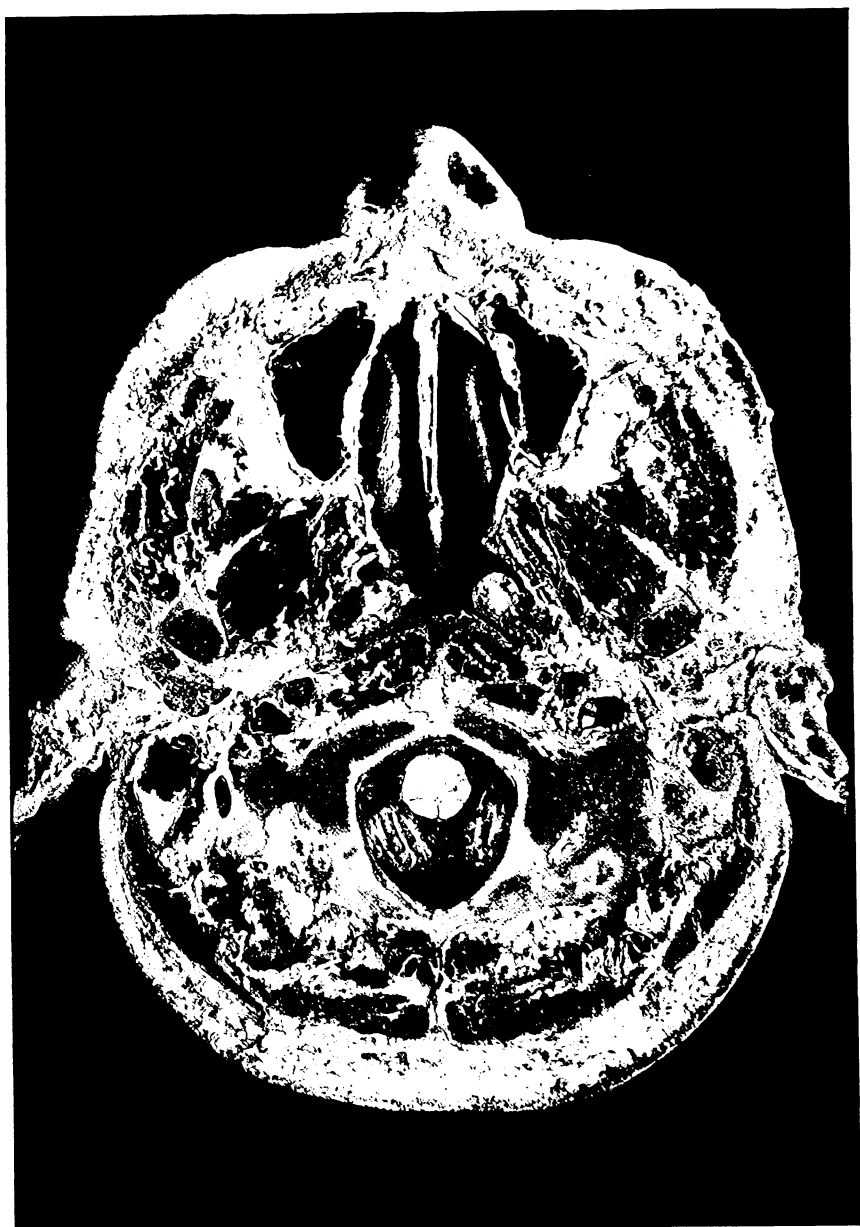


FIG. 4.



FIG. 5.

the relation of one tissue to another is false, consequently misleading. If these diagrams are used in order to become familiar with the names of the parts, or to talk of anatomy blindly to a student, or a member of an examining board, well and good; but the moment one undertakes surgical operations, whether intending to cut into the parts or change the relations of these structures with one another by any surgical operation or mechanical appliance, then diagrammatical knowledge is worse than useless.

To give a comparison between diagrammatical anatomy and that found in the cadaver soon after death, Figs. 3 and 4 are shown.

Fig. 3. Fig. 3 is made from a photograph of a vertical transverse bilateral frozen section, cut through the glenoid fossa of each side. The heads of the condyloid processes are shown in true relations with the glenoid fossa and other surrounding tissue.

The heads of the condyloid processes are shown in true relations with the glenoid fossa and other surrounding tissue.

Fig. 4. Fig. 4 is made from a photograph of a horizontal frozen section, cut through the head of the condyloid process of both sides. It shows the attachment of

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the external pterygoid muscle and other tissue within and surrounding the glenoid fossa.

The anatomy, the physiology and the pathology of the living subject, as nearly as possible, must be studied. In this discussion I will begin with the skull, as it is the framework upon which depend the form, the character and, to a great extent, the movements of the face.



FIG. 6.

Fig. 5.

Most of you are familiar with this skull as illustrated in Fig. 5; it has been discussed and re-discussed. It is a typical skull of a white person. The position of the condyle in relation to the glenoid fossa is about normal, and the space between the bones in the living subject is filled by various structures such as hyaline cartilage, synovial-membrane, the inter-articular fibro-cartilage, the blood vessels, etc. The teeth are in good occlusion and alignment; you would all be pleased to get such results from your treatment of malocclusion. One of the reasons for showing this specimen at this time, is to draw particular attention to the relation in a typical skull, of the articulation with the external auditory meatus. The glenoid fossa is usually described as situated under the base of the zygomatic process, bounded in front by the anterior root of the zygoma, posteriorly by the auditory process. It is this latter process to which I would like to draw your particular attention. It is a thin bony

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partition between the glenoid fossa and the ear, and in many skulls there is but slight space between the condyle and this thin lamina of bone. It stands to reason that if any interference should be brought about which would cause the condyloid process to be carried backward either by surgical operation or mechanical appliance, absorption would likely take place. In the collection of skulls at the Dental Department of the University of Pennsylvania, several specimens can be shown in which the auditory process has been reabsorbed, causing the external auditory



FIG. 7.

meatus and the glenoid fossa to become one cavity. Before taking up the development and the growth of the surrounding tissue of the temporo-mandibular articulation, it may be well to give a little comparative anatomy of this joint. I have already said that in the mammalian the articular surface of the condyloid process of the mandible is convex; in all other vertebrates, which includes the birds, reptiles and fishes, it is concave.

Fig. 6. Fig. 6 gives a posterior view of the head of a large sea-turtle. In many of these three classes of animals spoken of, the concavity of the condyloid process is more marked than in this specimen. In the ruminant animal, such as the deer, the sheep and the ox, the temporo-mandibular articulation has the greatest freedom of movement, consequently the glenoid fossa is very shallow and changes but little throughout life.

Fig. 7. Fig. 7 gives a lateral view of a deer's skull.

Fig. 8. Fig. 8 gives the under-surface of the same with the mandible removed. It will be noticed how flat the glenoid cavity is, allowing great freedom of

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movement of the mandible in the ruminating action which is required to masticate the food. The articulation of the rodents gives a rather free movement as the teeth have two special functions, one of mastication, with the grinding teeth, and of gnawing, with the incisors. On general principles, however, there is but slight lateral movement. The change of

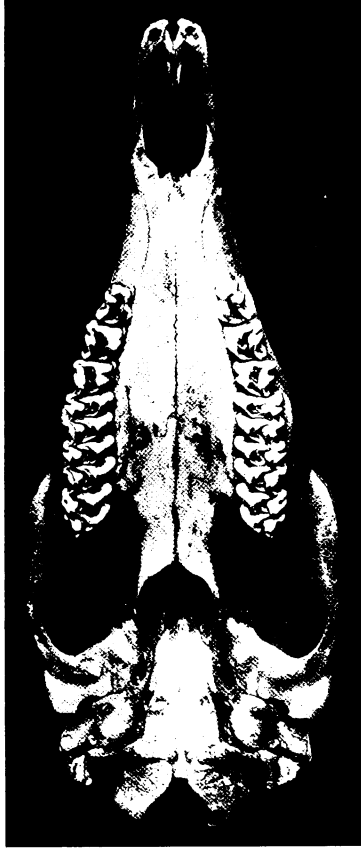


FIG. 8.

the relation of the process within the glenoid fossa or groove is antero-posteriorly; the condyle moves forward or backward, usually upon the same plane, which allows the grinding teeth to work independently of the incisor. In some cases when the incisors are brought into action the condyle has to be lowered in the glenoid fossa, in order that the incisors may come into contact with each other and at the same time contact of the grinding teeth is avoided.

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Fig. 9.

Fig. 9 is made from the under-surface of a skull and the upper-surface of the mandible of an African porcupine; it shows the occluding surface of both jaws, the groove-like glenoid fossa of each side, and the condyloid process of the mandible. By examination of the grinding teeth of the three specimens of the rodents, these will be found to vary to a great extent, one class being suited to one class of food, another, to another class of food.



FIG. 9.



FIG. 10.

Fig. 10.

Fig. 10 is a side view of the head of the *Hydrochoerus Capybara*, the largest rodent now living. It is of tropical America; the animal grows to the length of over three feet, and, as its name implies, is a water-loving animal. It will be noticed that when the grinding teeth are in occlusion the lower incisors are considerably posterior to the upper incisors. (I suppose I should say to this society that they are "distal" although really they are nearer to the center of the body.)

Fig. 11.

Fig. 11 is an under view of the same skull as Fig. 10. Notice the length of the glenoid (groove) fossa. The make-up of these teeth should be very interesting to all of us; they are formed of enamel plates, somewhat on the plan of the elephant, though the cement substance only binds the center of the plates, leaving knife-like edges on the lingual and buccal

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surfaces. The articulation allows but slight motion, but its antero-posterior (mesio-distal) motion is great. It is an animal that lives on vegetables entirely and it is claimed that "its curious teeth are needed in order to bruise the herbage on which it feeds into a mass sufficiently pulpy to enable it to pass through a very narrow throat."

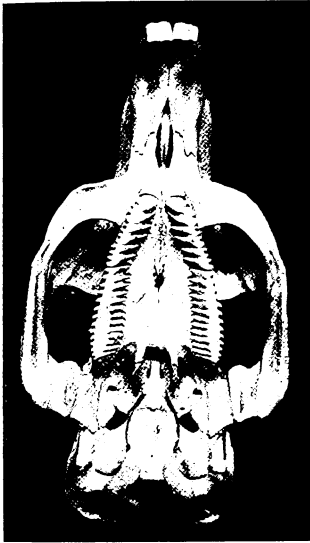


FIG. 11.

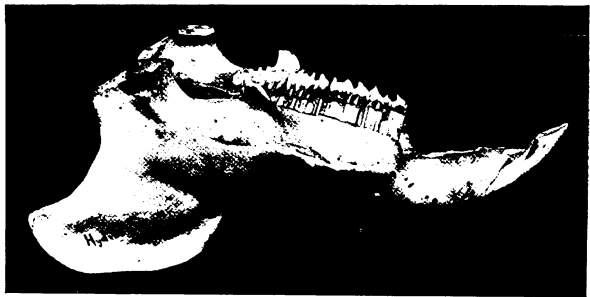


FIG. 12.

Fig. 12.

Fig. 12 gives a lateral view of the mandible of the same skull as shown in Fig. 10; it will be noticed that the condyloid process, the occluding surfaces of the grinding teeth and the cutting edges of the incisors are nearly on a straight line and that the angle of the jaw extends backward beyond the vertical line of the condyles.

Figs. 13 and 14.

Fig. 13 is made from a side view of the North American muskrat. As in the *Hydrochoerus*, when the grinding teeth are in occlusion there is a considerable distance between the points of the incisor teeth of the upper and lower jaws, demonstrating the distance the lower incisors have to be carried forward, *not mesially*, before they can come in correct occlusion, and, in so doing, the jaw has not only to be carried forward, but in this particular specimen the condyles have to descend as well, in order that the grinding teeth do not prevent the gnawing operation of the incisors, as is well shown in Fig. 14, which is made from the same specimen as shown in

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Fig 13. In this animal, there must have been a great latitude in the movement of the temporo-mandibular articulation. Thus it is shown what great latitude of movements are provided for in the ruminants and, to some extent, in the rodents of Africa and South and North America.

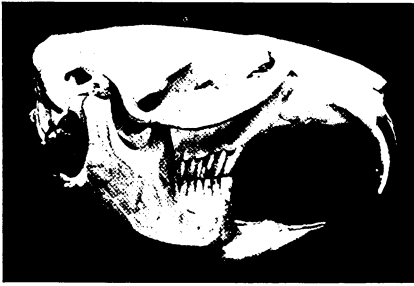


FIG. 13.



FIG. 14.

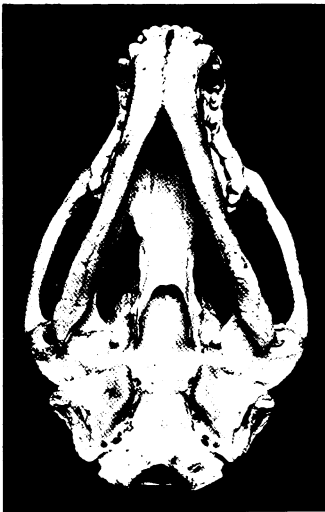


FIG. 15.

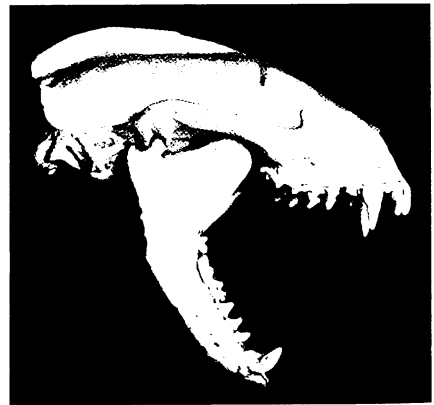


FIG. 16.

In the carnivora the temporo-mandibular articulation is contrasted strongly with that of the ruminants, as to giving free movements. In the highest type it is a fixed hinge joint with no forward or lateral movements. The highest type I know of is the badger.

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Fig. 15. Fig. 15 gives an under view of an American badger's skull. It will be noticed that the condyloid process of the mandible is more than half surrounded by the anterior and middle roots of the zygoma.

Fig. 16. Fig. 16 gives a side view of the same head as that shown in Fig. 15. It is here shown how the head of the condyle is firmly grasped by the anterior and middle roots of the zygoma. Incidentally it might be said that it



FIG. 17.

would be somewhat difficult or impossible to "jump the bite" where we had such an articulation.

Fig. 17. Fig. 17 is a side view of the skull of the wolf. There is much more latitude of movement than in the tiger, at the same time the middle root of the zygoma extends downward, which allows some freedom of movement, but prevents a backward dislocation.

Fig. 18. Fig. 18 is an under view of a wart-hog of West Africa. The glenoid fossa is very shallow, and when the mandible is in articulation with the condyloid process it rests upon the *eminencia articularis*, making two convex processes forming the articulation, consequently giving great freedom of motion. This condition is found in many other animals.

Fig. 19.

Fig. 19 gives a side view of a porcarius (hog) baboon. The specimen belongs to Dr. Kirk. It will be noticed in this case that the condyloid process

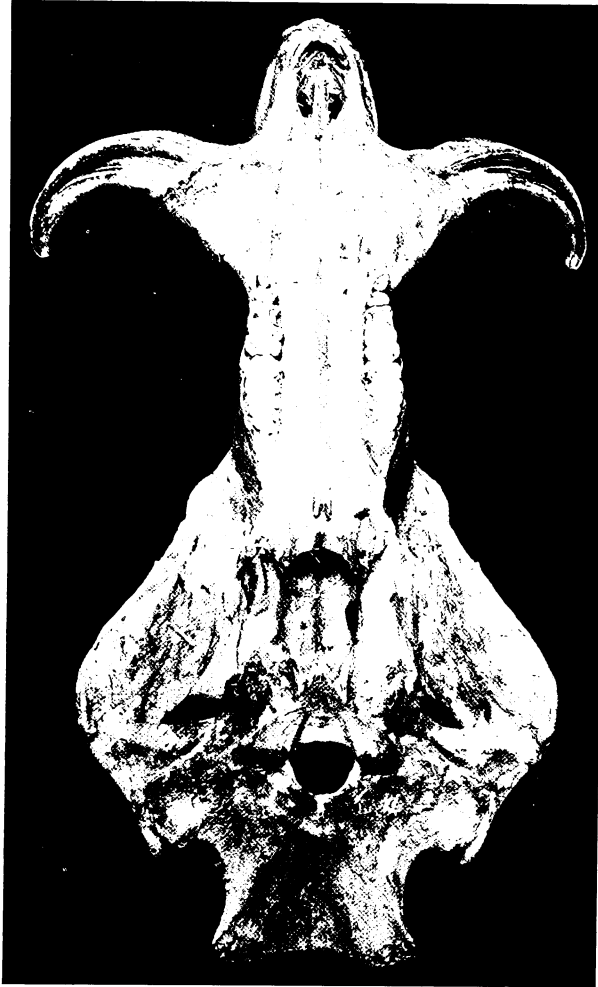


FIG. 18.

articulates directly upon the anterior root of the zygoma, and that the middle root passes downward, forming a guard to the condyloid process.



FIG. 19.

Fig. 20. Fig. 20 is a side view of the skull of a gibbon. The temporo-mandibular articulation is more like that shown in the skull of man (Fig. 5). The teeth also approach those of man; even the alveolar process shows evidence of pyorrhea alveolaris having existed. Of course, this is common in many of the lower animals.

Fig. 21. Fig. 21 is made from a side view of a chimpanzee skull. It shows an articulation very little different from that of man. The ramus of the mandible is also similar to that of man.

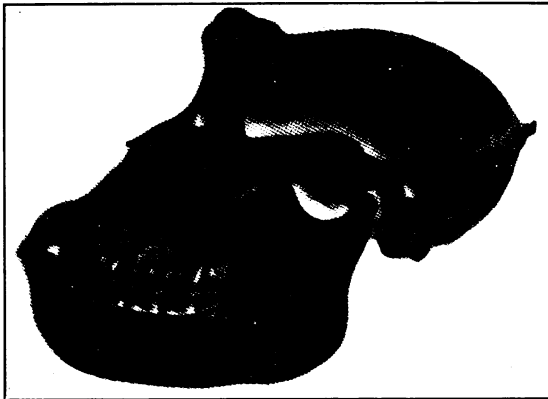


FIG. 20.



FIG. 21.

Fig. 22. Fig. 22 is made from the under view of the same skull as shown in Fig. 21. It shows a shallow glenoid cavity somewhat similar to that of a child cutting its first permanent molar. As is shown in this specimen all the deciduous teeth are still in position.



FIG. 22.

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Fig. 23.

Fig. 23 is made from a side view of a human skull of about the sixth or seventh month of fetal life. The mandible is suspended in the glenoid fossa which is flat and shallow, the condyles are rounded and short. Posterior to the fossa, a ring is well shown; it is the auditory ring upon which the tympanic membrane is suspended, and also upon it the greater portion of the wall of the external auditory canal is built; there is but slight

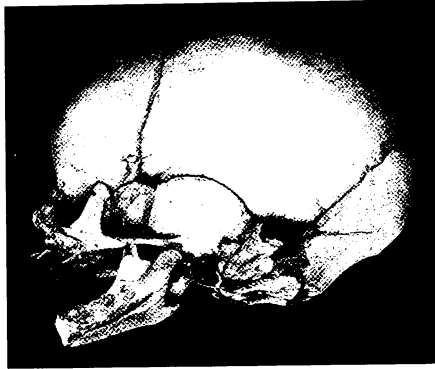


FIG. 23.

change until some time after birth. Every man and woman should know what little protection the articulation and the special organ of hearing have at birth and for some time afterward. A blow upon the ear may show ill effects in after life. An inflammatory condition brought about in this region during the development of the auditory process and the glenoid fossa is, in my mind, the cause of several kinds of malocclusion; especially of a forward bite. In regard to injuries inflicted upon this region at the time of birth, several papers have been written. There is room for others. The relations of the jaws at the time of birth should be studied; of course, they will not be exactly alike in all cases, but a general average will find the lower jaw occluding within the circumference of the upper one. If the lower jaws were found on an even line with the upper or in advance of it, there would be reason to think the condyles had been carried forward from their normal position, especially if the child had been a breech presentation or had required delivery by forceps. Every *accoucheur* should understand this, and means, at the time of birth, or soon afterward, should be used to correct the misplacement.

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Fig. 24.

Fig. 24 is made from an under view of a human skull at the time of birth. The jaws are closed. It will be observed that the lower "bites" within the upper. The condyloid process is in close juxtaposition to the auditory process. The process is somewhat thicker than that shown in Fig. 23. The external tympanic membrane has been preserved, but has no bony protection, as will be found a little later in life.



FIG. 24.

Fig. 25.

Fig. 25 is made from a side view of a child's skull, at about the age of four or five months. The deciduous teeth are causing the alveolar process to form rounded prominences over them; the condyloid process is more developed; the angle of the jaw is somewhat changed as compared with Fig. 23. The auditory process is better formed; the groove for the external tympanic membrane is well shown.

Fig. 26.

Fig. 26 is made from the same skull as Fig. 25, giving a half view of the base and side. It will be noticed how close the condyloid process is to the



FIG. 25.



FIG. 26.

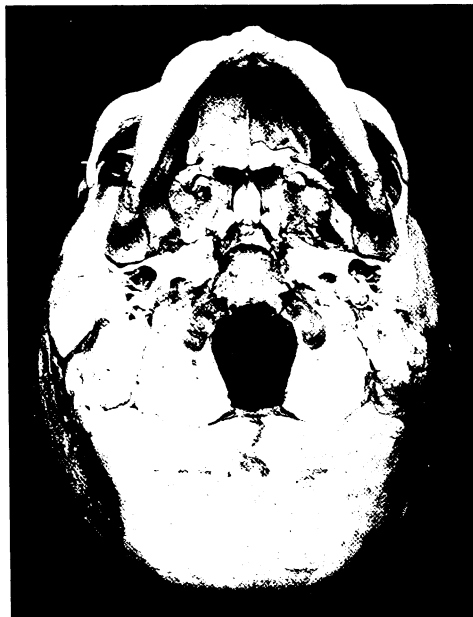


FIG. 27.

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developing auditory process. The external tympanic membrane is removed and the ossicles of the ear are brought into view.

Fig. 27. Fig. 27 is made from the under surface of a skull in which the ear bones are plainly seen. The handle of the malleus, which originally was part of the same cartilage (Meckel's), from which the mandible was formed, is well shown. It also demonstrates the close relation to the developing external auditory plate and canal.

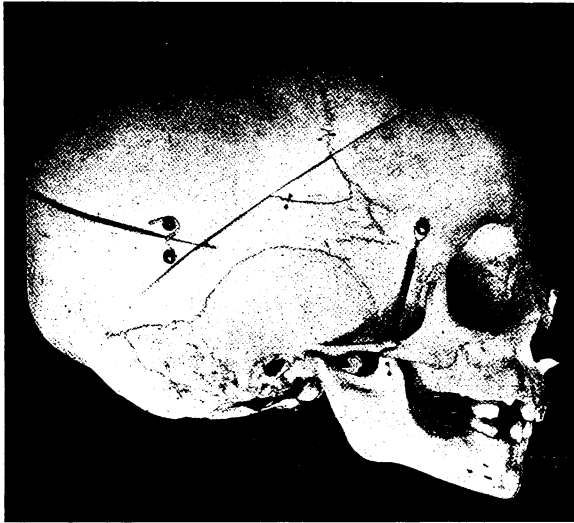


FIG. 28.

Fig. 28. Fig. 28 is made from a side view of a child's skull about eighteen months of age. The first deciduous molars are in position, but not in proper occlusion, as the mandible is carried slightly forward, which can be seen by examining the articulation. At this age the auditory process is fairly well formed.

Fig. 29. Fig. 29 is made from the same skull as Fig. 28, giving a view of the inferior surface. It shows the dehiscence, an opening in the tympanic plate, still patulous at this age, but which normally becomes filled in with bone as the tympanic plate develops. In some cases this dehiscence remains open through life, or the tympanic plate as a whole fails to be formed, making one cavity of the glenoid fossa and the external auditory canal.

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Fig. 30.

Fig. 30 is a side view of a skull that was used by Dr. Kirk in discussing a paper of Dr. Talbot in regards to "jumping the bite"; this was about fifteen years ago. The skull offers marked evidence that the man had brought about a "jumped bite" by carrying his jaw forward on the left side in order to bring into occlusion a few remaining teeth. The condyloid process is carried forward until it rests on the *eminentia articularis*. Both the condyloid process and the *eminentia* are flattened, the bones

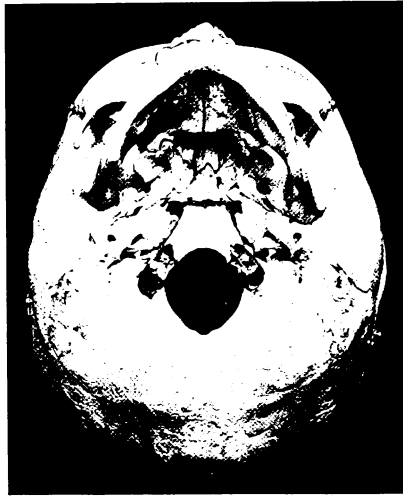


FIG. 29.

coming into undue contact, which caused a certain amount of resorption, and at the same time the inflammatory excitement of the osteoblasts caused bone to build around the edge, making the articulating surfaces broader than they would naturally be.

Fig. 31.

Fig. 31 is made from the opposite side of the same skull, as Fig. 30. The articulation is more of a pivot joint, and has not had the ability to move on to the articulating eminence.

Fig. 32.

Fig. 32 is a side view of a skull belonging to the Peabody Museum of Harvard University. I am indebted to Dr. Howe, of Boston, for three photographs of this skull. It exhibits a massive jaw with an acute angle, and at the same time forming a "forward bite," which, I think, is rather un-

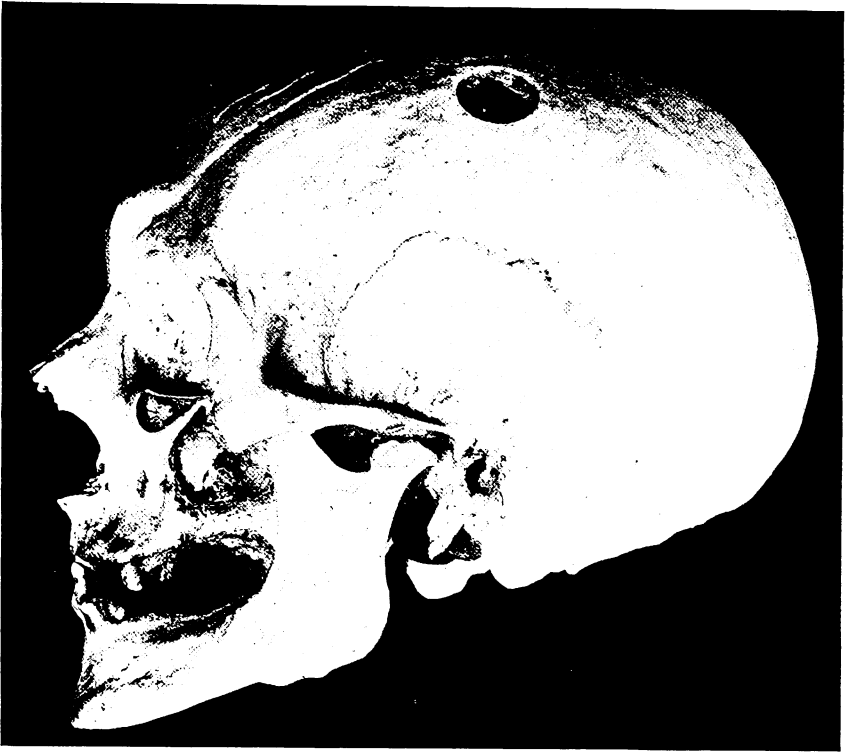


FIG. 30.

common; but when the articulation of the two sides of the skull (see Figs. 32 and 33) are examined it will be found that the condyloid processes are carried forward upon the articulating eminences, and at the same time it would appear that if the lower jaw were carried back by any mechanical means, resorption of the auditory process would take place.

Fig. 33 is made from a side view of the same skull, as shown in Fig. 32. The general character is the same. The temporo-mandibular articulation is somewhat more deformed than that shown in Fig. 32.

Fig. 34 is made from an upper view of the mandible of the same skull as shown in Figs. 32 and 33. It will be noticed that the condyloid processes, especially the right, are modified through the general pathological changes of the temporo-mandibular articulations.



FIG. 31.

Fig. 35.

Fig. 35 is made from a frozen sagittal section cut through the condyloid process and the glenoid fossa. The view is looking outward from the internal portion of the face. Just behind the condyloid process the soft tissue can be seen. There is also a pathological opening through the posterior wall of the fossa into the auditory canal and middle ear which extends backward into the mastoid cells, and there is also an opening externally through the mastoid process which is not shown in the picture. Pathological conditions extending from the mastoid process through the ear to the glenoid fossa are often found. Therefore, when the orthodontists do anything that may change the relation of the articulation, they should take into consideration the possible pathological changes that could be brought about.

Fig. 36.

Fig. 36 is made from a side view of an aged skull where all the teeth have been lost, and where the chin is carried upward and forward in making

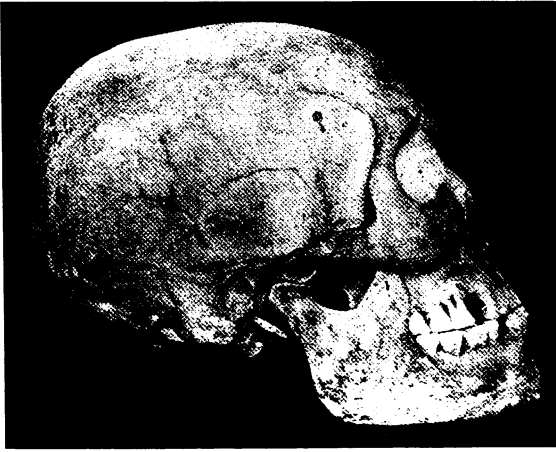


FIG. 32.

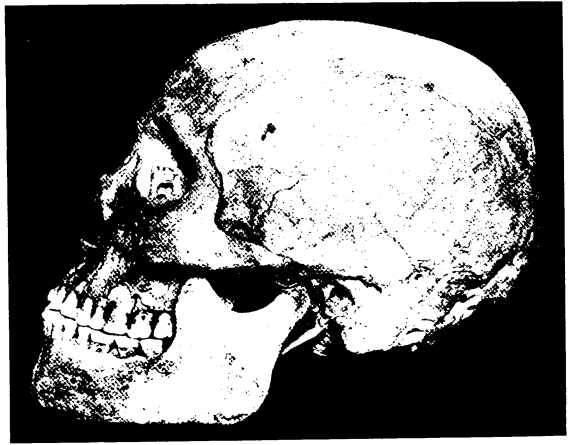


FIG. 33.

its circle, while endeavoring to have the lower jaw come in contact with the upper one; the muscular tissue, in cases of this kind, also endeavors to force the jaw backward, so much so, that the condyloid processes are forced against the posterior portion of the glenoid fossa, which often causes resorption of the bone allowing the condyloid processes to partially or wholly close the auditory canals, causing deafness. This is so common that the aurist when examining the ears of many aged persons is compelled to have the patient open the mouth widely; in so doing the external pterygoid muscle draws the head of the condyle forward, which allows the speculum to be pressed into the auditory canal.

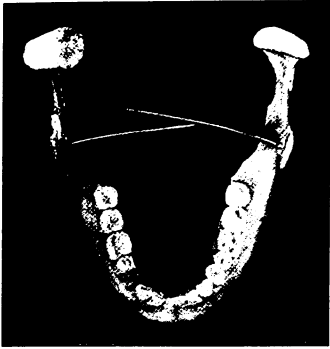


FIG. 34.



FIG. 35.

Fig. 37. Fig. 37 is made from a side view of a skull which shows teeth in a forward occlusion of about one-half the width of a molar tooth. Compare it with Fig. 5. Although it has the forward bite, the condyloid process is placed well back in the glenoid fossa. It will be noticed that the auditory process has either never been formed or that it has been lost by resorption through some pathological condition. It is possible that this man wore some mechanical appliance for carrying the jaw back in order to overcome the malocclusion. In some cases I fully believe that "jumping

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a bite" backward the width of half a molar tooth could bring about such a result as is here shown.



FIG. 36.



FIG. 37.

Fig. 38.

Fig. 38 is made from a side view of a skull with a diseased external auditory canal; the greater portion of the division between the glenoid fossa, the middle ear, and the external auditory canal has been lost by disease. The positions of the teeth and other abnormal conditions indicate that there has been a general disturbance in this region from early life.

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Fig. 39.

Fig. 39 is made from a side view of the same skull, as shown in Fig. 38. Here again the auditory process has been lost, the condition of the canal indicating disease for some time before death. The teeth of this side of



FIG. 39.



FIG. 38.

the skull are also in malposition. No one in such cases should undertake to make a general correction of the deformities in the positions of all these teeth, as I have seen general and serious ill health caused by a too sweeping correction of irregularities. This is one of many rea-

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sons why I feel most strongly that an orthodontist should, like the President of the United States, think before he acts.

If I may have a slide (Fig. 8 of Dr. Weeks) I will call attention to one little fact. Dr. Weeks said, in referring to this skull, that it was of a child about five years of age, and that the relation of the teeth on the left side was normal, mesio-distally. The markings on the molar seem to indicate a distal articulation. It shows signs of being incorrect. At five years of age there should be growth spaces distal to centrals, laterals and cuspids in both upper and lower. We have a characteristic placing of these incisors and cuspids, such as we call a close bite in older cases. The significance of this seems to be that the portion of the mandible anterior to the mental foramen is very much under-developed. Another point, in this mandibular relation, is to find out whether we can shift the articulation. In some cases we seem to hold it after bringing the jaw forward. In other cases we get it forward and it slips backward again.

I said in my little preamble that we should look around the circle before we judge. I do not always do it, and I fear that neither Dr. Weeks nor Dr. Barnes did it. This is an abnormal skull in almost every way. I should say the child died of rickets. You can not judge that skull for a normal or typical one.

Dr. Cryer, how do you account for the distance there between the tympanic canal and the condyle of the jaw? (Fig. 10, Weeks.)

I think there has been more bone deposited there than belonged there. I would like to look at this skull, and hope Dr. Weeks will let me do so.

Does Dr. Cryer mean the whole cranial cavity is overgrown?

Yes, it is all wrong. It is out of all proportion, and I think any of you who have studied skulls would acknowledge that it is an abnormal one, and you can not study normal points from an abnormal skull.

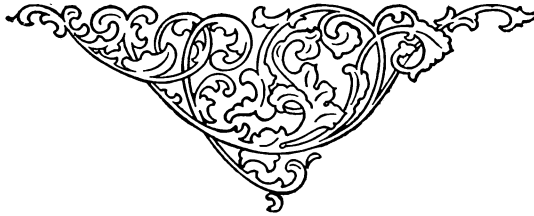
There is very little to say in closing the discussion of this paper. I do not well enough understand the question raised by Dr. Barnes to enable me to satisfactorily reply to him. I do not believe Dr. Barnes has, as yet, sufficient data to prove that one portion of the mandible may be under-developed while another may be fully developed. If this were applied to the alveolar process, as determined by the position of the teeth, I would fully concur with him.

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I do not believe you can explain the lack of prominence of the chin in all cases by saying that it is a lack of development of the mandible itself; if that were the case you would find that in cases of Class II there would be a general condition of impaction of the third molars. My observation and the observation of others does not lead me to believe this to be the rule. I have seen no more cases of impaction in Class II cases than in Classes I and III.

I do not wish to be understood to believe that in no case is there a lack of development of the mandible, but that in many cases the mal-occlusion may be due to abnormality of the temporo-mandibular articulation.

I can not see sufficient indication in the skull referred to to form the conclusion that it is generally in over-developed skull. Particularly, in closing, I wish to express my appreciation of the time and thought Dr. Cryer has been generous enough to give to the discussion of my paper. Also, to my indebtedness to him for the use, in illustration, of specimens from his valuable collection.





The Technique of the Cast Gold Inlay.

By CHARLES K. BUELL, D.D.S., Buffalo, N. Y.

Read before the Sixth District Dental Society, at Binghamton, May, 1909

The relief from mental, nervous and physical fatigue to both patient and operator renders it necessary for the practitioner of to-day to resort to the cast-gold inlay, if he would give to his patients the best service.

In the selection of the cases where we are to insert a cast-gold inlay, our enthusiasm should not be allowed to overbalance our judgment and result in our placing an inlay in a cavity that could be filled with a foil-filling in less time and with greater assurance of a permanent operation.

The writer would suggest the following as the cases where the cast-gold inlay is indicated. Patients of an extreme nervous temperament, or in a weak physical condition, for whom the placing of a foil-filling would be simply torture. Frail teeth that would not stand the continuous hammering required for the insertion of a foil-filling. Teeth too loose to permit the placing of a foil-filling. The majority of teeth that have been considered as subjects for the gold-shell crown, can be beautifully restored with the cast-gold inlay to years of usefulness. Many bridge abutments may be cast in the inlay form, thus necessitating less destruction of tooth structure with an equal degree of permanence.

There are certain principles that govern the shaping of the cavities for the cast-gold inlay, as well as for all filling materials, viz., convenience, retention and resistance to stress. There must be such a happy combination of these that when the cavity is formed the inlay will be retained in position, under stress, without the aid of cement. In other words, the cavity must be mechanically retentive, and no dependence should be placed upon the cement to withstand the force of mastication.

Cavity Formation.

I shall mention only four of the more important classes of cavities:

Class 1. Cavities in the morsal surface only, of molars (Fig. 1). The floor should be flat (Fig. 1 A). All fissures should be followed out, the walls of the

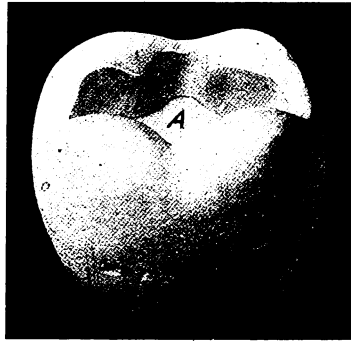


FIG. 1.



FIG. 2.

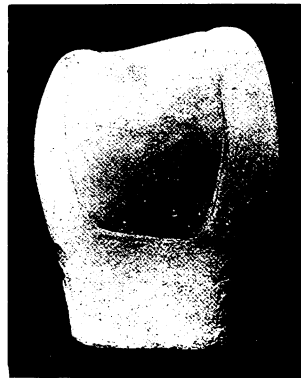


FIG. 3.

cavity should diverge slightly from the floor outward, thus protecting the enamel rods. Both cavity and inlay should be grooved before cementation.

Class 2. Cavities involving the morsal surface, and one approximal surface of molars and bicuspid (Fig. 2).

The seat of the cervix should incline slightly toward the axial wall. The axial wall may be nearly perpendicular. The labial and lingual walls should be extended so that they lie in a surface that is reached easily by the tooth-brush. This is especially necessary at the

angle formed by the buccal or lingual and the cervical wall, this being the most vulnerable point in the whole cavity (Fig. 2 A). The cement does not prevent decay, as is claimed by some. The occlusal portion should have a broad flat floor, with a step to lock the filling into position, or the surrounding walls may be shaped so as to form a dovetail retention. These surrounding walls must be prepared with great care so as to protect the enamel at all points (Fig. 2 B). There must be sufficient thickness of gold in the inlay at the angle formed by the occlusal floor

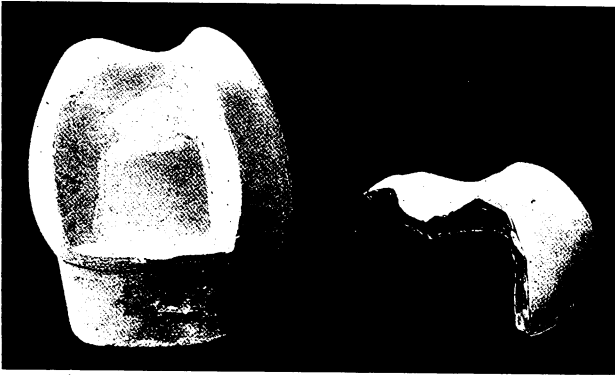


FIG. 4.

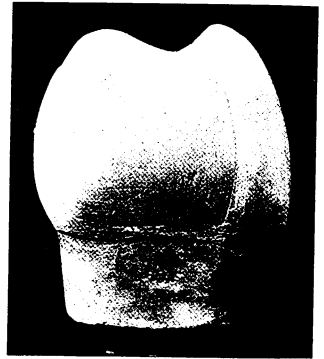


FIG. 5.

and the axial wall (Fig. 2 C) to prevent stretching of the gold at this point.

Fig. 3 shows the completed inlay in position in the cavity.

Fig. 4 shows the same class of cavity and inlay for the molar teeth.

Fig. 5 shows the inlay in position in the cavity.

Cavities in the morsal surface, and both ap-
Class 3. proximal surfaces of molars and bicuspid, from
 which the pulps have been removed. The buccal
 and lingual walls are all that is left of the tooth, and such teeth in the
 past have usually been crowned. In such a cavity the interior is restored
 with cement, and the cavity formed as follows: gingival, lingual, buccal
 and axial walls the same as in Class 2. The tips of the buccal and lingual
 natural cusps are ground away at an angle inclining slightly toward the
 periphery of the tooth (Fig. 6 A, B), thus binding the buccal and lingual
 portions of the tooth together, preventing the fracture of one or both,
 an accident often seen in the foil-filled tooth. The cement restoration is
 removed and new cement placed at the time of cementation of the inlay.
 Fig. 6 C shows the inlay, and Fig. 7 the completed case. I have used

an extreme case in this illustration, and the same extreme may be applied to molars, provided the occlusion is carefully studied, as it is a large factor in the permanency of the inlay.

Class 4. Cavities involving one approximal surface and a portion of the incisive end of an incisor (Fig. 8).

Again the gingival seat is inclined slightly toward the axial wall, the latter being perpendicular; the labial and especially the lingual walls, must be so formed as to protect the enamel rods, and

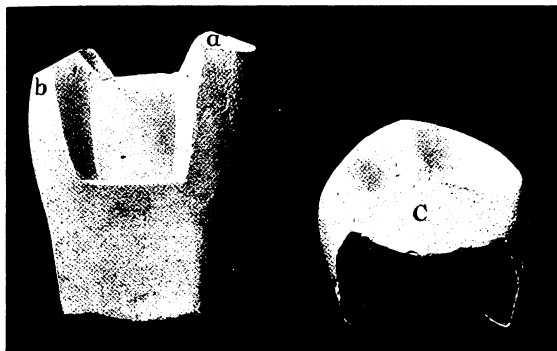


FIG. 6.

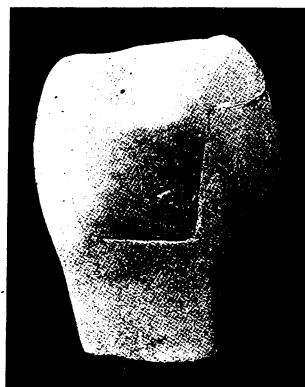


FIG. 7.

the incisive ends ground away as far as the cavity extends. Lingually, the cavity is so shaped as to form a step that locks the inlay securely in place. Care must be taken that the enamel is supported with dentin at A and B, Fig. 8.

Fig. 9 shows the completed inlay in position.

The inclination of the gingival seat toward the axial wall in Classes 2, 3 and 4 tends to force the inlay into the cavity during cementation.

In Classes 2, 3 and 4 proper separation is necessary in all cases. Temporary stopping placed in the cavity and allowed to remain for a few days accomplishes the result without any discomfort to the patient. At the same time any hypertrophied gum tissue is driven away, giving free access to all margins of the cavity.

In the forming of all cavities the withdrawal of the wax form must be constantly borne in mind, as any slight undercut will result in the destruction of the wax model, or in the failure to remove it. Should the cavity have undercuts that it seems best to retain, fill these with temporary stopping before forcing the wax into the cavity.

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Manipulation of the Wax.

To soften the wax cut a piece sufficiently large for the case, and impale it on some pointed instrument, holding it above the flame. Keep revolving it to prevent the dripping of the wax and evenly distribute the heat. When sufficiently softened, heat the instrument and drop the wax into the hand. Force it into the cavity at once, without manipulation, instructing the patient to close the jaws immediately. Warm the carver and cut away the excess; then scrape the wax to the desired form, always moving the instrument in a line parallel with the

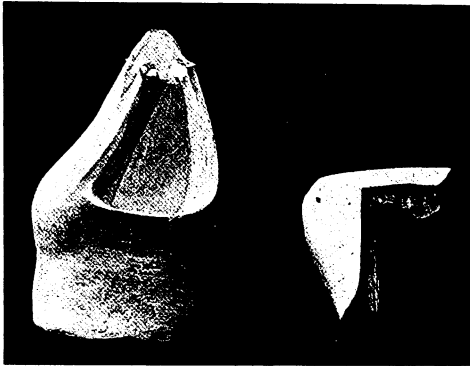


FIG. 8.

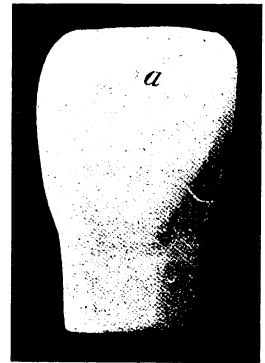


FIG. 9.

margin of the cavity, thus preventing the chipping of the wax at the margins. If the cavity is an approximal one, scrape to the general form desired. Pass a thin instrument between the wax and the adjacent tooth to allow the insertion of a strip with which to give the desired form to the wax. Polish with a cuttle-fish strip or silk ribbon. The occlusal surface of the wax is polished with a ball of cotton. A thin feather-edge is left on all margins. The sprue is then warmed and inserted in the wax while it is still in the cavity, whenever admissible; thus there is little possibility of injury to it as the fingers need never touch it. The point of contact is now restored by adding a little wax with the spatula, and, if grooves are desired in the inlay, they are now cut in the wax with a sharp bur in the dental engine.

Investing.

A coating of thin investment is now painted upon the wax with a small camel's-hair brush, as it is held on the sprue, to a thickness of at least one-fourth of an inch. As soon as this is set somewhat, the ring is placed over it and filled. When thoroughly set remove the crucible former with a twisting motion. Heat the sprue and remove it in the same manner. Place the case on a wire screen over Bunsen burner with flame split.

As soon as steam ceases to rise, turn on more gas, and when the chocolate color has burned off the investment, leaving it white, it is ready to cast.

What metal shall we use for our inlays? To ascertain this cubes of 24 k. gold, 22 k. gold and 5 per cent. platinous gold of exactly the same size were subjected to pressure with the following results:

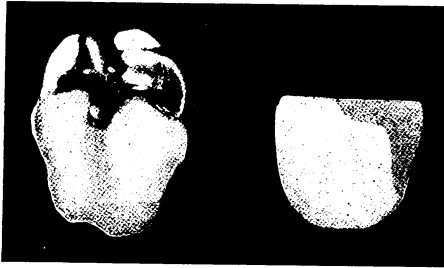


FIG. 10.

24 k.	22 k.	5 per cent. Platinous gold.
100 pounds pressure yields 3 points.	3 points.	1 point.
200 pounds pressure yields $5\frac{3}{4}$ points.	$7\frac{3}{4}$ points.	$6\frac{1}{2}$ points.
275 pounds pressure yields $14\frac{3}{4}$ points.	$10\frac{1}{2}$ points.	10 points.
300 pounds pressure yields 21 points.	15 points.	12 points.

To be assured of success in casting, it is necessary to have a clean button of gold each time, which can be obtained with the blowpipe and charcoal block, using borax and saltpeter half and half. The cast inlay should be washed and brushed, then pickled in hydrofluoric acid until all traces of the investment are removed.

**Seating and
Finishing.**

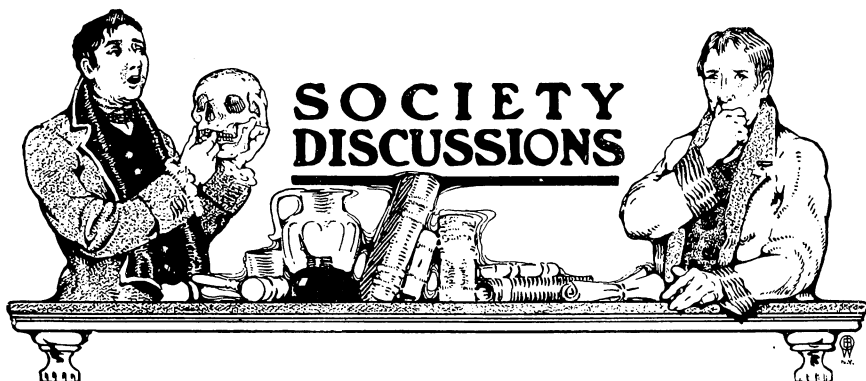
The inlay is placed in the cavity and driven home with the pine stick and mallet. Burnish the feather-edge down and finish with stones, strips and disks, flush with the margin of the cavity. In this manner the overhanging feather-edge is all cut away. Remove, wash inlay and cavity with alcohol, dry and cement into place.

The seating of a perfect inlay is often spoiled by the use of a cement of too thick a consistency to allow it to go to place.

Go around the margins with a burnisher while the cement is still soft, thus sealing the joint. When cement is thoroughly set give the inlay its final polishing.

Fig. 10 shows completed inlays in extracted teeth.

In all the classes of cavities taken up this evening, the angular form is one that has been used instead of the rounded form, as it produces a cavity with a definite form and seat, also an inlay that can not be rocked out of position during cementation.



Second District Dental Society. February Meeting.

A regular meeting of the Second District Dental Society of the State of New York, was held on Monday evening, February 8, 1909, at the Kings County Medical Library Building, No. 1313 Bedford Avenue, Brooklyn, N. Y.

The president, Dr. Hillyer, occupied the chair and called the meeting to order.

Dr. F. H. Nies then read a paper entitled, "Lost Castings: Causes and Remedies."*

Discussion of Dr. Nies's Paper.

**Dr. Chayes,
New York.**

I have listened to the reading of Dr. Nies's paper with considerable interest, because I have met the failures he has tried to eliminate. I do not know that there is any particular point that is more worth discussing than the shrinkage of the investing material, and the tapering of the flask is probably the only way to overcome that. However, the taper he has on his flask I should think is a trifle too abrupt, and where a great deal of shrinkage has taken place in the investing material, and a great deal of expansion in the flask, a drop such as this would be liable to cause the investing compound to scatter into the mold under pressure. A taper probably one-quarter of the extent shown has been found sufficient in my experience to obviate any escape of air to the bottom of the flask.

When the casting process first became so generally used, I invested

*This paper appeared in the July issue. Ed.

my money in a centrifugal machine, and I found that the flasks as they existed were absolutely worthless. First, there was a formation of steam that made it almost impossible to have a perfectly dried-out material, unless you superheated it; secondly, the generation of steam was so great and so sudden that particles would pop out into your eye before you had a chance to dry it. So I perforated the side with a large bur, and that gave me much more security and a much more perfect investing material after it was dried out.

The trouble I have found is: that no matter how careful you are in selecting an investing material, the inlay is a trifle larger than the cavity, and, unless you are careful in trimming off what looks like a lot of fine beads under the magnifying glass, you will be likely to have an inlay that may not fit perfectly.

Another difficulty is the tendency to spread in large inlays when made of pure gold, and for that reason an alloy of platinum and gold will be an improvement. I understand Dr. Ottolengui has from many experiments decided upon an alloy made of gold with five per cent. platinum. That has a great resistance to spreading.

Drying out was spoken of. I think if you will use the sand bath you will find it useful. I use an old-fashioned stove and place a piece of tin on it; and then I take some sand and put a low flame under it. Later put a high heat on, and you will have very little trouble with it. I allow about twenty minutes to half an hour for the first stage, and during the other stage I just watch it.

For an investment I use three parts of fine siliceous and one of plaster, and that in my hands is ideal. I bring out my castings almost perfect. In very large castings there is some contraction, to be sure. I put in three bridges last week that were cast bridges. Two of the bridges carried two dummies, and one had one dummy. Yesterday I inserted a whole plate, four teeth on each side back of the cuspids, and there were fourteen pennyweights of gold on each side. It made it a heavy case, and rather expensive, but it was done in an ordinary copper cylinder, cut from an old copper pipe which cost me twenty-five cents.

I do not use a Taggart machine. I get out all sorts of bridges and inlays and castings, and I simply use my thumb; and I accomplish the purpose just as well. (Laughter.)

When the doctor says he needs an oxygen blowpipe, I take exception to that. I just use the footblast, and have no trouble.

There is one thing I have found absolutely essential, however, and that is slowly drying out your flask. Dry it with the slow heat until it is

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absolutely free from steam. There is a case drying out on my Baltimore heater now. I find the thorough drying out important. When there is a lot of wax to be melted out it makes the cast very black, and you should not use the blowpipe until it is all burned out, and is white again.

I found in my experience that two causes of failure are: one, the overheating of the model, and the other an escape in the pressure of air. Sometimes I have expansion of the ring, which might cause escape of the pressure between the investment and the ring. By using an asbestos washer below I prevent that. I can not see how the investment can shrink and still deliver an enlarged inlay. I always claim that any shrinkage occurring would take place from without inward, and the inlay naturally would be smaller. I use oxygen combined with gas for heating my metal.

Dr. Arvine. How does the investment compound you have made compare with that of Dr. Nies'?

Dr. Arvine. It is practically the same thing, with the addition of a little clay. I think the clay keeps tighter to the ring than silex and plaster. I have used one part of silex, one part clay and one and one-half parts of plaster, and have had very few failures, although occasionally I have some; but I generally find some small detail has been neglected in the technique.

Dr. Chayes. The reason the inlay is not smaller after your investment has shrunk, is because of the hollow mold. When you have a hollow inside there is a tendency to shrink away from the hollow, and the more intense heat you use, the more the outer portion of the mold dries out and pulls away from the mold, giving you a larger inlay.

The doctor spoke of being careful in using borax. I avoid that as I would rat poison. Even in crowns, when casting on to a platinum shell, I would not use any flux with it. I would be afraid to use borax or any other flux, lest it be forced into the investment.

Dr. Lewis. I think we should be grateful to Dr. Nies for describing the many causes of failure, and for the scientific reasons he has given for those failures. However, I would like to talk to some of the men who have not had all these failures; I am one of them. I had failures when I started, but I found it to be an error in technique. I did have an investment drop from the ring at first, but I have not dropped any investing materials lately.

While I was glad to hear the paper, and to know what to do when such things happen, I can say that they have not happened to me, and I would like to hear from some of the other men as to their experience.

Dr. Nies.

I thank you for the many kind things you have said about my paper, and I am grateful for some of the criticisms. Dr. Chayes made the statement that he thought the taper of the ring is too great. I do not think so. I tried a number of tapers, some of them more extreme and others less so. I found those of lesser taper did not hold my investment as tightly as I wished, so I adopted a happy medium. The degree of tapering depends entirely on the investment you use. The silex and plaster investment, although it shrinks very little, does not always give the best castings. There are times when you want another kind of investment, especially when casting diatoric incisor crowns. Then I prefer French chalk instead of silex, although the shrinkage is against it when used in the ordinary ring; but in the tapered ring it works perfectly. Although we may note considerable shrinkage in a ring that is about an inch across, still in the actual inlay which covers, perhaps, one-sixteenth of an inch, that is hardly perceptible; so I do not think it is very much affected by shrinkage.

Dr. Babcock, I think, mentioned the doing away with the porosity of the investment. I like to have it porous, because I think that one is more successful with it. Molders have recognized that for centuries. They never make a casting without venting it, and even in our own large castings—great cavities that include all the surface of a molar—I have considered it a good thing to vent the molds, because I used to lose quite a number when I have not done so. A simple thread inserted is an excellent vent, and is pulled out later.

Formerly I had a great many failures in casting pure gold with the ordinary blowpipe. I would lose four or five out of ten. Other gentlemen may have had different experiences, and perhaps I did not understand the cause of my failures. I was able to get better results with lower grades of gold, and I see no reason why a man should particularly want to cast in 24 k., especially for molar or bicuspid fillings. There is no particular advantage in it, and the chances for success in a lower karat are always greater. I have never seen any discoloration, although I have cast a great many in 22 k. gold.

Thurston, in his book on metal and alloys, quotes an authority who declares that it is impossible to actually get a true alloy of platinum and gold. This authority proves conclusively that there never has been such a thing. Examination of a cross-section of a bar of patinum and gold shows that there never has been a true alloy.

Dr. D. W. Barker then read a paper entitled, "Porcelain Inlays without a Furnace." (See July issue.)

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I will preface my paper by saying Dr. Hillyer originally suggested that I give a demonstration. I should have preferred to do so, as I think it would have been easier; but the room is not properly equipped, therefore it could not be done. The porcelain referred to in my paper is always the Jenkins. It is the only kind I have had any experience with.

I have here some porcelain inlays. One of them is of the very light-blue shade which is so difficult to retain perfectly, and burns out so easily.

Discussion of Dr. Barker's Paper.

Dr. Barker's idea of making porcelain inlays, without a furnace, is very attractive for several reasons: First, it would seem to settle the question of expense incident to the purchase and maintenance of a costly furnace, the repairing of which is a most important and extravagant item; second, saving time necessary in heating up and cooling off an electric furnace for each layer of porcelain body applied to the inlay; and, third, the probable disappointment in color (and perhaps the baking) which arises from the fact that the glaze is put on before the inlay is built out to the margins, an error that can, and is, invariably made, because the shrinkage of the porcelain deceives us, and we are obliged to add more glaze, which ruins the color; but nearly all porcelain workers put it on just the same, regardless of the effect, for the form of the tooth when inlay is inserted must be considered. The best operators fail more in the color than in the actual fitting. The fitting is simple, the color is the problem.

But how can we use porcelain without a furnace? We save time in baking very small inlays. I have not succeeded in baking a large piece of porcelain in a flame, and with the Jenkins gas furnace the color is often burned out. Dr. Barker claims that any size filling can be baked thoroughly throughout in the flame. Now, if Dr. Barker can do this, and we all learn his technique, what is the use of wasting time with a furnace? Surely the color stands a better chance in a small flame. From my experiments with this method (using the Jenkins porcelain body) I find it incompetent; first, it does *not* thoroughly fuse an inlay of medium size throughout; second, while the smaller inlays seem to be fused, yet they are extremely brittle; and, third, I have not been able to make a corner for an incisor. All these objections have been overcome by using the electric furnace, which, of course, consumes time.

There is another objection to Dr. Barker's method. He uses gold for the matrix because gold does not absorb as much heat as the platinum foil. I do not think that gold should ever be used unless imbedded in

investment compound, because gold will change form in the flame, weighted down by the inlay body while being held at one point with the pliers. Of course the investment is out of the question in Dr. Barker's method, as it would absorb too much heat.

There is, however, one advantage in this method, and that is, in deciding the color or combination of colors (to be finally baked in the electric furnace), as one can in a moment fuse a button of Jenkins porcelain body on a piece of gold foil, adding or reducing the quantity of the several shades until a button is fused that will match the tooth to be filled.

I have had some experience along the line of Dr. Barker's paper, and I must say I have had better success with the Jenkins body when baking in the matrix direct than I have had when investing the matrix. The only difference there is between Dr. Barker's method and the way I have followed, is that I use the platinum matrix, for the reason that I was always of the impression that the gold matrix was more likely to be fused at the degree of heat which is necessary. I have used the simple Bunsen flame rather small, but a little larger than Dr. Barker evidently used, and the only necessity seems to be to keep a little closer watch to see that you do not overfuse the body. I have had greater success in retaining the color than I ever did with the furnace. The furnace I have used for that purpose has long since been discarded, along with the other refuse of my office.

In approximal cavities in incisors this method of fusing the porcelain direct in the matrix has certainly proven successful in adaptation to the cavity, and in the general color scheme, and retaining the color, which, as I said before, I was seldom able to do with the furnace.

Dr. Barker spoke about investing the matrix when fusing the second or third portions of porcelain. It would seem to me to be almost necessary to keep that surface well under your eye, and I do not see how you could do it, if it were upside down. That is one of the ways I have of seeing that it is not overfused—by watching it closely.

I would like to ask whether Dr. Barker refers to the ordinary Jenkins body, or whether this is a specially low fusing body.

Dr. Barker. The ordinary body.

I have not had much experience, but I used the Jenkins body at one time, and I used the electric furnace, and I had more or less trouble in retaining the color, and in filling out corners, because there was so little difference in the point of fusing, that when I added a little more, the whole mass was inclined to slump. I prefer a high fusing body.

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When I first took up porcelain work, I used the
Dr. Rehfsom. Jenkins body, but I had great difficulty in maintaining the color, using the electric furnace, so I discontinued it. I have not had much experience with it. With the high-fusing body we have an opportunity to restore badly decayed teeth to perfect form and color; and in approximal incisal cavities porcelain is especially indicated, as well as on labial surfaces, in any of the six front teeth. It is quite remarkable how well porcelain will stand stress when it is properly fused, and not "broiled"; but you must remember that a great many of you have been in the habit of "broiling" the porcelain, and when you do that, it is not strong and easily fractures under severe stress. I myself have had large porcelain restorations in some of my incisors. They were not "broiled"—they were fused—by Dr. John Q. Byram, of Indianapolis. They have been in my mouth three years, and, although I have an even bite, a very close bite, and they have been subjected to the most severe tests indeed, they still remain in place. Although the natural teeth have worn away by attrition, leaving the porcelain inlays longer than the body of the tooth, they are as firm as ever. There never was a cement line to wash out, because the fit was perfect. You can see for yourself, after the meeting, if you wish, that it is just in those cavities where it is indicated, and where I take pleasure in using it to the great satisfaction of myself and the delight of the patients.

I can not quite see how Dr. Barker avoids warping in a large filling, especially when not invested.
Dr. C. C. Van Woert.

When heating over the flame I do not see how he gets a distribution of the heat as even as in an electric furnace, where the whole inlay is in the furnace.

Since I left college, in 1905, I have not inserted a malleted gold filling. I started out as an amateur, putting the porcelain inlays in the anterior teeth, and I do not think I have had over two or three come out, and as long as they keep up like that I will not go back to gold.

I would like to ask Dr. Barker if he knows that the Jenkins body changes color before it is exposed to heat. Exposure to light and aging will change the color. The Jenkins people will admit that.

I am glad Dr. Croscup has had some experience with this method, and I think that he has had somewhat the same difficulty I had, and that Dr. Hamlet has apparently had—what I call the fire-check. In fusing a filling of considerable size, I was very much puzzled to account for that. I could not understand why a filling with which I had taken considerable pains would be ruined. It was apparent that Dr. Hamlet thought it was not

SOCIETY DISCUSSIONS

fused enough. It took me quite a long time to understand the trouble, and then it was easy; now I raise the temperature of the previously fused porcelain to almost the fusing point before inverting it, and that is why the gold matrix is as efficient as the platinum.

One gentleman spoke of not understanding about putting the filling back in the matrix. What I was speaking about was in matching a doubtful filling. Suppose you have a patient of lymphatic temperament, with a muddy shade of teeth that you can not match unless you combine three or four shades. Take a piece of gold foil, and having mixed your different combinations of shades, fuse it, peel off the metal, and try it in the tooth. Say it wants a little more blue or yellow—try it again. You can keep on doing that until you get the shade you want.

Dr. Wollison.

I understood you built in your matrix.

Dr. Barker.

No; I build on a piece of gold. Someone asked if I knew the Jenkins body lost its color by aging. I did not know that.

President Hillyer.

Do you mean age without exposure to light?

Dr. Walker.

Yes; I believe the Jenkins people will exchange any bottles that are two years of age. They will not fuse true to color if they are over two years of age.

I think about three or four months after I bought my outfit I had difficulty in getting the proper shades. I attributed it to faulty technique. The Jenkins people were giving an exhibition at the time, and I sent two or three samples of the body down and asked them to try it for me, and they had worse success than I had.

Dr. Barker.

If the gentlemen will give this half as earnest a trial as the furnace method, they will be pleased with it; and if any one has any difficulty I will try to give them all the assistance in my power.





A New Faculties Association.

The formation of a new Faculties Association will be of great interest to all who have at heart the progress of dental education. The new association comes into existence under the following circumstances:

On July 31, 1908, a conference was held in Boston attended by representatives of the dental departments of the universities of California, Harvard, Michigan, Minnesota and Pennsylvania. The question discussed was the advisability of forming an Association of the Faculties of the Dental Departments of American Universities. After considering a draft of a constitution presented by Dr. James Truman, Dr. J. G. Sharp, representing the Dental Department of the University of California, was made temporary chairman, and the meeting adjourned to meet at the call of the chairman.

A meeting was called by the chairman, and was held at the Bellevue-Stratford Hotel in Philadelphia on June 5, 1909, for the purpose of effecting a permanent organization. Those present were: Dr. J. G. Sharp, University of California; Dr. E. H. Smith, University of Harvard; Dr. N. S. Hoff, University of Michigan; Dr. G. V. I. Brown, University of



Iowa; Dr. Alfred Owre, University of Minnesota, and Dr. Edward C. Kirk, University of Pennsylvania.

A constitution and by-laws were adopted and the following officers were elected: President, Dr. J. G. Sharp; vice-president, Dr. Eugene H. Smith; secretary-treasurer, Dr. Edward C. Kirk.

The association will be known as the "University Dental Faculties Association."

**The Ultimate
Passing of
Proprietary Schools.**

The formation of this new Faculties Association, of course, has no ulterior motive; it is but an association of coworkers, and is for the advancement of common interests. But it requires no prophet to predict that within a comparatively short number of years the proprietary dental college will have disappeared. In the beginning, the independent dental school, owned and managed by dentists, was undoubtedly a necessity, and all honor must ever be yielded to the Baltimore Dental College for establishing the fact that dentistry had arrived at a period in her history when she required and was determined to have a school system of her own. Overtures had been made to the medical profession to recognize dentistry and to add dental teachers to medical faculties. The proposition was refused; hence, the founding of the dental college, and the first institution thus started is still respected by all.

But it quickly became evident that dentistry, being a craft as much as a science, required a training school. The hands, as well as the head, needed teaching. Hence, the dental infirmary became a necessary adjunct, and, unfortunately, in the early days the dental infirmary soon brought a stigma upon dental education. For it was more than apparent that these infirmaries could be made to yield a profit; that, indeed, there was more financial gain in an infirmary than in a private practice. A deep unrest came upon the profession and grew as the privately owned dental schools increased in numbers. Scandalous charges were commonly made in private, and all too often in the dental press, but, like many evils, this one was almost self-limiting. The very growth of the number of schools minimized the profit-taking element.

Meanwhile, the founding of the National Association of Dental Faculties, the enacting of dental statutes requiring State's license to practice, the organization of State examining boards, and the formation of the



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National Association of Dental Examiners, all became factors which have mightily improved the general status of dental education. Later the Pedagogic Association has done much to awaken in the hearts and minds of the dental teachers the importance of learning how to do that which they profess to do. The teaching systems of other institutions, and especially of the sister schools of medicine, have been studied, and improved methods of imparting knowledge introduced into our dental colleges.

But a factor more potent than all of these has been at work; an influence which has been slowly but surely altering all the great industries of the world. The spirit of association; of the joining of forces; of concentration; of cooperation.

In the educational field this concentration, this cooperation, gives us the university, and it is a significant fact that while minor schools come and go, rise, flourish and fall, the university goes on, and on, and on, always growing in strength, in influence and in its aggregate number of branches. The dental profession should be proud to realize to what an extent it has been adopted into the great universities of this country.

The Catholic Church has ever appreciated the importance of education. Its parochial and convent schools are important the world over. The Jesuits, or Society of Jesus, constitute a band of nineteen thousand priests devoted to preaching and teaching. It may surprise many to learn that already the Jesuits own and control five universities in the United States, each of which has a dental department. One of these, Marquette University of Wisconsin, recently held commencement exercises which signally typified cooperation in the medical branches. On the same day it graduated and awarded diplomas to four classes: a class of medical men, a class in dentistry, a class in pharmacy, and a class of trained nurses.

It is, therefore, from the signs of the times (and this new Faculties Association is but one of the signs) that the prophecy may be made that the private dental school of to-day must seek and obtain affiliation with a university, or be content to see its classes lessen and its doors finally closed. The university system of education must and will prevail. It is futile to even attempt to stem the tide, nor is it to the interest of dentistry that it should be turned back from her shores.